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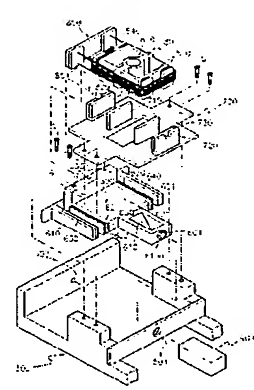
(54) Optical pickup

(57) An optical pickup includes: a rotary block (600) installed in a fixed base (500) to be rotatable; a holder (850) integrally coupled to the rotary block (600); a bobbin (800) supported by a predetermined wire (840) of the holder (850) to be movable; a base plate (700) fixed to the fixed base (500) and placed between the rotary block (600) and the bobbin (800); an objective lens (810) mounted in the bobbin (800), for focusing an incident light to form a spot of light on a recording medium; a focusing coil (820) and tracking coils (830) installed in the bobbin (800), serving as a current flow path for focusing and tracking operations; first magnets (730) and first inner and outer yokes (710; 720) installed in the base plate (700), facing the focusing coil (820) and the tracking coils (830), for producing magnetic fields perpendicular to the current flowing through the focusing coil (820) and the tracking coils (830) to produce an electromagnetic force for driving the bobbin (800); a fixed optical system (900) for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens (810); a reflecting mirror (820) for changing the traveling path of the incident light, the reflecting mirror installed in the rotary block (600) to be arranged between the objective lens (810) and the fixed optical system (900); tilt coils (621, 622) serving as a current flow path, the tilt coils (621, 622) installed at both sides of the rotary block (600); and second magnets (630) and second inner and outer yokes (640; 650) installed facing the tilt coils (621, 622), for producing magnetic fields perpendicular to the current flowing through the tilt coils (621, 622) to produce an electromagnetic force for rotating the rotary block (600). Therefore, the tilt of the optical axis of the light incident onto and reflected by an optical disk through the reflecting mirror (820) and the objective lens (810) can be adjusted according to the tilt of the recording medium, such that the light is perpendicularly incident onto and reflected by the recording medium all the times.

FIG. 27



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Description

[0001] The present invention relates to an optical pickup for irradiating light onto a recording medium to record information in the recording medium and to read information therefrom.

[0002] In general, an optical recording/reproducing apparatus such as a disc player, for recording information in a recording medium such as an optical disk and reproducing information therefrom, comprises an optical pickup for reading information from light that is irradiated onto the optical disc and then reflected therefrom. In a conventional optical pickup, as shown in Figures. 1 and 2, a base plate 21 is installed on a fixed base 20, and a bobbin 23 in which an objective lens 19 is mounted is movably supported by a wire 28 in a fixed block 22 situated on the base plate 21. Also, a focusing coil 26 for controlling the focus of a spot of light formed on the optical disk 30, and a tracking coil 27 for laterally moving the objective lens 19 such that the spot of light formed on the optical disk 30 accurately tracks the tracks (not shown) of an optical disk 30, are installed in the bobbin 23. The bobbin 23 moves by an electromagnetic force due to interaction between a current flowing through the focusing coil 26 and the tracking coil 27, and the magnetic field produced by a magnet 25 and a yoke 24 installed in the base plate 21. A reflecting mirror 18 for changing an optical path, and a fixed optical system 10 for irradiating light through the reflecting mirror 18 to the optical disk 30 and receiving the light reflected by the optical disk 30 are placed below the objective lens 19. As shown in Figure 1, the fixed optical system 10 includes a light source 11, a beam splitter 13, a collimating lens 14, a detecting lens 15 and a photodetector 12. Also, each semispherical base of the fixed base 20 and the base plate 21 contact each other and are coupled by a plurality of adjusting screws 41, 42 and 43, such that the tilt of the base plate 21 with respect to the fixed base 20 can be adjusted by tightening the plurality of adjusting screws 41, 42 and 43. This structure is suitable for correcting an error through the controlling of the tightness of the adjusting screws 41, 42 and 43 during the assembly process in the case when an optical axis C of light incident through the objective lens 19 perpendicularly onto the optical disk 30 is tilted, that is, when the light is obliquely incident, not perpendicularly, onto the optical disk 30. Reference numeral 50 represents a controller for controlling the focusing and tracking operations, and reference S represents a compression spring.

[0003] However, the optical disk 30 may be tilted due to vibration during the recording/reproducing operation as well as during the assembly process, and the optical disk 30 may not be level due to minute deformations of the optical disk 30 itself. However, the conventional optical disk can not cope with such a problem. In other words, even when the tilt of the optical axis C during the assembly can be corrected, the tilting of the optical axis C during the recording/reproducing operation after the assembly process cannot be corrected. As a result, the intensity of light formed on the optical disk is not strong enough for the recording and a playback signal is deteriorated, so that it is difficult to accurately reproduce the information.

[0004] It is an aim of embodiments of the present invention to provide an optical pickup adopting an enhanced structure in which the tilt of an optical axis of a light being incident onto and reflected from an optical disc through a reflecting mirror and an objective lens is controlled such that the light is perpendicularly incident onto and reflected from the recording medium at all times.

[0005] According to an aspect of the invention, there is provided an optical pickup comprising: a fixed base; a base plate installed rotatable with respect to the fixed base; a bobbin seated on the base plate, being movably supported by a predetermined wire; an objective lens for focusing an incident light to form a spot of light on a recording medium, the objective lens mounted in the bobbin; focusing coils serving as a current flow path for a focusing operation, the focusing coils installed in the bobbin; first magnets and first yokes for producing magnetic fields perpendicular to the current flowing through the focusing coil to produce an electromagnetic force for driving the bobbin, the first magnets and first yokes installed in the base plate; a fixed optical system for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens; a reflecting mirror for changing the traveling path of the incident light, the reflecting mirror arranged between the objective lens and the fixed optical system, being fixed to the base plate; a support arm having one end fixed to the fixed base and the other end rotatably supporting the reflecting mirror, serving as a rotary shaft of the base plate to which the reflecting mirror is fixed; and a tilt means for rotating the base plate using the support arm as a rotary shaft, to adjust the tilt of an optical axis passing through the objective lens and the reflecting mirror.

[0006] According to another aspect of the invention, there is provided an optical pickup comprising: a fixed base; a base plate installed rotatable with respect to the fixed base; a hollow boss formed to protrude on the base plate; a bobbin coupled to the boss to be movable in the vertical direction; an objective lens for focusing an incident light to form a spot of light on a recording medium, the objective lens mounted in the bobbin; focusing coils serving as a current flow path for a focusing operation, the focusing coils installed in the bobbin; first magnets and first yokes for producing magnetic fields perpendicular to the current flowing through the focusing coils to produce an electromagnetic force for driving the bobbin, the first magnets and first yokes installed in the base plate; a fixed optical system for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens; a reflecting mirror for changing the

traveling path of the incident light, the reflecing mirror arranged between the objective lens and the fixed optical system, being fixed to the base plate; a support arm having one end fixed to the fixed base and the other end rotatably supporting the reflecting mirror, serving as a rotary shaft of the base plate to which the reflecting mirror is fixed; and a tilt means for rotating the base plate using the support arm as a rotary shaft, to adjust the tilt of an optical axis passing through the objective lens and the reflecting mirror.

[0007] According to still another aspect of the invention, there is provided an optical pickup comprising: a fixed base; a base plate in the fixed base, being supported by springs to be rotatable; a bobbin seated on the base plate, being supported by a predetermined wire to be movable; an objective lens for focusing an incident light to form a spot of light on a recording medium, the objective lens mounted in the bobbin; a focusing coil and tracking coils serving as a current flow path for focusing and tracking operations, the focusing coil and tracking coils installed in the bobbin; first magnets and first yokes for producing magnetic fields perpendicular to the current flowing through the focusing coil and the tracking coils to produce an electromagnetic force for driving the bobbin, the first magnets and first yokes installed in the base plate; a fixed optical system for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens; a reflecting mirror for changing the traveling path of the incident light, the reflecting mirror arranged between the objective lens and the fixed optical system, b eing fixed to the base plate; and a tilt means for elastically rotating the base plate elastically supported by the springs, to adjust the tilt of an optical axis passing through the objective lens and the reflecting mirror.

[0008] According to yet still another aspect of the invention, there is provided an optical pickup comprising: a fixed base; a rotary block installed in the fixed base to be rotatable; a holder integrally coupled to the rotary block; a bobbin supported by a predetermined wire of the holder to be movable; a base plate fixed to the fixed base and placed between the rotary block and the bobbin; an objective lens for focusing an incident light to form a spot of light on a recording medium, the objective lens mounted in the bobbin; a focusing coil and tracking coils serving as a current flow path for focusing and tracking operations, the focusing coil and tracking coils installed in the bobbin; first magnets and first inner and outer yokes for producing magnetic fields perpendicular to the current flowing through the focusing coil and the tracking coils to produce an electromagnetic force for driving the bobbin, the first magnets and first inner and outer yokes installed in the base plate, facing the focusing coil and the tracking coils; a fixed optical system for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens; a reflecting mirror for changing the traveling path of the incident light, the reflecting mirror installed in the rotary block to be arranged between the objective lens and the fixed optical system; and a tilt means for rotating the rotary block to adjust the tilt of an optical axis passing through the objective lens and the reflecting mirror.

[0009] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is a sectional view showing the structure of a conventional optical pickup;

Figure 2 is a plane view of the conventional optical pickup shown in Figure 1;

Figure 3 is a sectional view showing the structure of an optical pickup according to a first embodiment of the present invention;

Figure 4 is a plane view of the optical pickup shown in Figure 3;

Figure 5 is a perspective view showing the main elements of the optical pickup shown in Figure 3;

Figures. 6 and 7 are diagrams illustrating the principle of a tilt operation of the optical pickup shown in Figure 3;

Figures. 8 through 10 are diagrams illustrating an adjustment operation of the optical pickup shown in Figure 3 to compensate for the tilt of an optical disk;

Figure 11 is a perspective view showing the structure of an optical pickup according to a second embodiment of the present invention;

Figure 12 is a sectional view of the optical pickup shown in Figure 11;

Figure 13 is a plane view of the optical pickup shown in Figure 11;

Figures. 14 and 15 are diagrams illustrating the focusing operation of the optical pickup shown in Figure 11;

Figures. 16 and 17 are diagrams illustrating the adjustment operation of the optical pickup shown in Figure 11 to compensate for the tilt of an optical disk;

Figure 18 is a sectional view showing the structure of an optical pickup according to a third embodiment of the present invention;

Figure 19 is a plane view of the optical pickup shown in Figure 18;

Figure 20 is a perspective view showing the main elements of the optical pickup in Figure 18;

Figures. 21 through 23 are diagrams illustrating the principle of a tilt operation of the optical pickup shown in Figure 18;

Figures. 24 through 26 are diagrams illustrating the adjustment operation of the optical pickup shown in Figure 18 to compensate for the tilt of an optical disk;

Figure 27 is an exploded perspective view of an optical pickup according to a fourth embodiment of the present invention;

Figure 28 is a perspective view of the assembled optical pickup shown in Figure 18; and

Figure 29 is a diagram illustrating the adjustment operation of the optical pickup shown in Figure 27 to compensate for the tilt of an optical disk.

[0010] An optical pickup according to a first embodiment of the present invention, in which a bobbin is supported by a wire, will be described with reference to Figures. 3 through 10.

[0011] Referring to Figures. 3 through 5, a base plate 210 is arranged on a fixed base 200, and a bobbin 230 is movably supported by a wire 280 connected to a fixed block 220 above the base plate 210. Also, an objective lens 190 for focusing an incident light to form a spot of light on a recording medium such as an optical disk 300 is mounted in the bobbin 230, and focusing coils 260 serving as a current flow path for focusing operation is installed. Also, first magnets 250 and first yokes 240 for producing magnetic fields perpendicular to the current flowing through the focusing coils 260 to produce an electromagnetic force for driving the bobbin 230 are installed in the base plate 210. Also, the optical pickup according to the first embodiment of the present invention comprises a fixed optical system 100 for irradiating light onto the optical disk 300 and receiving the light reflected by the optical disk 300. The fixed optical system 100 is constructed of a light source 110, a beam splitter 130, a collimating lens 140, a detecting lens 150 and a photodetector 120. Also, a reflecting mirror 180 for changing the traveling path of an incident light is arranged between the objective lens 190 and the fixed optical system 100. The reflecting mirror 180 is fixed to a pair of arms 211 extended from the base plate 210 to be integrally movable with the base plate 210. Also, one of the arms 210, which shields the base of the reflecting mirror 180, has a predetermined coupling bar 181, and the coupling bar 181 is rotatably coupled to a support arm 182 fixed to the fixed base 200. Thus, the support arm 182 supports the entire base plate 210 including the reflecting mirror 180 against the fixed base 200, and simultaneously serves as a rotary shaft of the base plate 210 by rotatably supporting the reflecting mirror 181.

[0012] Also, there is a tilt means for adjusting the tilt of an optical axis C passing through the objective lens 190 and the reflecting mirror 180 by rotating the base plate 210. The tilt means comprises tilt coils 430 attached to each outer wall of the first yokes 240 to provide a current flow path, and second magnets 420 and second yokes 410 installed in the fixed base 200 to produce magnetic fields perpendicular to the current flowing through the tilt coils 430, thereby producing an electromagnetic force capable of rotating the base plate 210. Here, the pair of tilt coils 430 are symmetrically arranged centering around the bobbin 230, facing each second magnet 420. Also, as shown in Figures. 6 and 7, the tilt coils 430 are arranged such that only inner vertical parts thereof overlaps the second magnet 420. In this overlapped state, current I flows through the pair of tilt coils 420 in the direction indicated by arrows as shown in Figure 6, the effect of the current horizontally flowing through the tilt coils 420 is offset, and an electromagnetic force is produced in the direction F due to the interaction between the current I that flows vertically and the magnetic fields B produced by the second magnets 420, so that the base plate 210 rotates clockwise on the support arm 182 coupled to the coupling bar 181. On the contrary, when current I flows through the tilt coils 430 in the direction indicated by arrows as shown in Figure 7, an electromagnetic force is produced in the direction F due to the interaction with the magnetic field B by the second magnets 420, so that the base plate 210 rotates counterclockwise. Thus, the rotation direction of the base plate 210 can be controlled by controlling the direction of current flowing through the tilt coils 430. Reference numeral 500 represents a controller for controlling the current flowing through the tilt coils 430 and through the focusing coils 260.

[0013] In the optical pickup constructed as above, when the optical disk 300 for a data recording/reproduction is level as shown in Figure 8, current does not flow through the tilt coils 430 and accordingly the base plate 210 maintains the level state without rotation. In this state, the focusing operation by the focusing coils 260, the first magnets 250 and the first yokes 240 is also performed.

[0014] Also, when the optical disk 300 tilts to the right as shown in Figure 9, the controller 500 allows current to flow through the tilt coils 430 in the direction indicated in Figure 6 to rotate the base plate 210 clockwise such that the optical axis C passing through the objective lens 190 and the reflecting mirror 180 is incident perpendicular to the optical disk 300. That is, the base plate 210 is rotated being tilted as much as the optical disk 300 such that the optical axis C is perpendicular to the optical disk 300.

[0015] Meanwhile, when the optical disk 300 tilts to the left as shown in Figure 10, the controller 500 allows current to flow through the tilt coils 430 in the direction indicated in Figure 7, to rotate the base plate 210 counterclockwise.

[0016] The tilting of the optical axis C passing through the objective lens 190 and the reflecting mirror 180 can be dynamically offset by rotating the base plate 210 according to the tilt of the optical disk 300.

[0017] Also, the optical pickup according to the first embodiment of the present invention can perform the tracking operation by using the above-described tilt means. That is, while rotating the base plate 210 using the electromagnetic force produced by the tilt coils 430 and the second magnets 420, the optical axis C is microscopically moved for tracking. Thus, the optical axis C is macroscopically adjusted in accordance to the tilt of the optical disk 300 through the tilt operation, and then the base plate 210 is microscopically rotated in a state such that the tracking is performed along the tracks of the optical disk 300. In general, the optical axis rotates in the range of about ±1° during the tilt operation, and rotates in a microscopic range of about ±0.25° during tracking. Thus, the tracking operation can be performed without extra coils and magnets for the tracking.

[0018] An optical pickup according to a second embodiment of the present invention will be described with reference to Figures. 11 through 17, in which a bobbin is not supported by a wire unlike the optical pickup according to the first embodiment, and a bobbin is inserted into a predetermined boss to be slidably movable in the direction of the optical axis.

[0019] Referring to Figures. 11 through 13, a predetermined base plate 210a is installed to be rotatable in a fixed base 200a. Such rotatable supporting structure will be described later. Also, a bobbin 230a in which an objective lens 190a is mounted is coupled to a hollow boss 201 formed on the base plate 210a. The bobbin 230a can rise by itself being coupled with the boss 201a, however its movement is restricted in the horizontal direction. Thus, the entire base plate 210a must be moved in order to move the bobbin 230a in the horizontal direction. Also, first magnets 250a and first yokes 240a for producing electromagnetic forces capable of driving the bobbin 230a by producing magnetic fields perpendicular to the direction of the current flowing through the focusing coils 260a are installed on the base plate 210a. Reference numeral 261a represents iron cores for concentrating magnetic flux. Also, the first magnets 250a and the focusing coils 260a are arranged to face each other, and are arranged to overlap each other as shown in Figures. 14 and 15. Also, two first magnets 250a having opposite polarity are arranged in the vertical direction, to produce magnetic fields in opposite directions. When current I flows through the focusing coil 260a as shown in Figure 14, the electromagnetic force acts upward according to the Fleming's law, thereby raising the bobbin 230a by the electromagnetic force. On the contrary, when current I flows through the focusing coil 260a as shown in Figure 15, the electromagnetic force acts downward, thereby lowering the bobbin 230a.

[0020] Also, as shown in Figure 12, the optical pickup according to the second embodiment of the present invention comprises a fixed optical system 100a for irradiating light toward an optical disk 300a and receiving the light reflected by the optical disk 300a. The fixed optical system 100a comprises a light source 110a, a beam splitter 130a, a collimating lens 140a, a detecting lens 150a and a photodetector 120a. Also, a reflecting mirror 180a for changing the traveling path of an incident light is installed between the objective lens 190a and the fixed optical system 100a. The reflecting mirror 180a is fixed to a pair of arms 211a extending from the base plate 210a to be integrally movable with the base plate 210a. Also, one of the arms 211a, which shields the base of the reflecting mirror 180a, has a predetermined coupling bar 181a, and the coupling bar 181 is rotatably coupled to a support arm 182a fixed to the fixed base 200a. Thus, the support arm 182a supports the entire base plate 210 in addition to the reflecting mirror 180a against the fixed base 200a, and simultaneously serves as a rotary shaft of the base plate 210a by rotatably supporting the reflecting mirror 180a.

[0021] Also, there is a tilt means for adjusting the tilt of an optical axis C passing through the objective lens 190a and the reflecting mirror 180a by rotating the base plate 210a. The tilt means comprises tilt coil 430a attached to the outer wall of the bobbin 230a, second magnets 420a and second yokes 410a installed in the fixed base 200a, for producing magnetic fields perpendicular to the current flowing through the tilt coils 430a to produce an electromagnetic force capable of rotating the base plate 210a. Here, the pair of tilt coils 430a are symmetrically arranged centering around the bobbin 230a, facing each second magnet 420a. Also, as shown in Figures. 16 and 17, the tilt coils 430a are arranged such that only the inner vertical parts thereof overlap the second magnets 420a. Reference numeral 500a represents a controller for controlling the current flowing through the tilt coils 430a and the focusing coils 260a.

[0022] In the optical pickup constructed as above, when the optical disk 300a is level, current does not flow through the tilt coils 430a and accordingly the base plate 210a maintains the level state without rotation. In this state, the focusing operation by the focusing coils 260a, the first magnets 250a and the first yokes 240a is also performed.

[0023] Also, when the optical disk 300a tilts to the right as shown in Figure 16, the controller 500a allows current to flow through the tilt coils 430a in the direction indicated in Figure 16. Here, the effect of the current horizontally flowing through the tilt coils 430a is offset, and an electromagnetic force is produced in the direction F due to the interaction between the current I that flows vertically and the magnetic fields B produced by the second magnets 420a, so that the base plate 210a rotates

clockwise on the support arm 182a coupled to the coupling bar 181a. That is, the base plate 210a is rotated being tilted as much as the optical disk 300a such that the optical axis C is perpendicular to the optical disk 300a.

[0024] On the other hand, when the optical disk tilts to the left as shown in Figure 17, the controller 500a allows current to flow through the tilt coils 430a in the direction indicated in Figure 17. Accordingly, an electromagnetic force is produced in the direction F due to the interaction with the magnetic fields B produced by the second magnets 420a, so that the base plate 210a rotates counterclockwise. Thus, the rotation direction of the base plate 210a can be controlled by controlling the direction of current flowing through the tilt coils 430a. Thus, the tilting of the optical axis C passing through the objective lens 190a and the reflecting mirror 180a can be dynamically offset by rotating the base plate 210a.

[0025] Also the optical pickup according to the second embodiment of the present invention can perform the tracking operation by the above-described tilt means. That is while rotating the base plate 210a using the electromagnetic force produced by the tilt coil 430a and the second magnet 420a the optical axis C is microscopically moved for the tracking Thus, the optical axis C is macroscopically adjusted in accordance to the tilt of the optical disk 300a through the tilt operation, and then the base plate 210a is microscopically rotated in a state such that the tracking operation is performed along the tracks of the optical disk 300a Thus, the tracking operation can be performed without extra coils and magnets for the tracking in this embodiment.

[0026] Referring to Figures 18 and 20, a base plate 210b is installed in a fixed base 200b, the base plate 210b being supported by springs 440b to tilt by a predetermined angle and a bobbin 230b is movably supported by a wire 280b connected to a fixed block 220b above the base plate 210 Also, an objective lens 190b for focusing an incident light to form a spot of light on a recording medium such as an optical disk 300b is mounted in the bobbin 230b, and focusing coils 260b and tracking coils 270b serving as a current flow path for focusing and tracking operations are installed. Also, first magnets 250b and first yokes 240b for producing magnetic fields perpendicular to the current flowing through the focusing coils 260b and the tracking coils 270b to produce an electromagnetic force for driving the bobbin 230b are installed in the base plate 210b. Also, the optical pickup according to the third embodiment of the present invention comprises a fixed optical system 100b for irradiating light onto the optical disk 300b and receiving the light reflected by the optical disk 300. The fixed optical system 100b is constructed of a light source 110b, a beam splitter 130b, a collimating lens 140b, a detecting lens 150b and a photodetector 120b. Also, a reflecting mirror 180b for changing the traveling path of an incident light is arranged between the objective lens 190b and the fixed optical system 100b. The reflecting mirror 180b is fixed to a pair of arms 211b extended from the base plate 210b to be integrally movable with the base plate 210b. Also, there is a tilt means for adjusting the tilt of an optical axis C passing through the objective lens 190b and the reflecting mirror 180b by rotating the base plate 210b. The tilt means comprises tilt coils 430b attached to each outer wall of the first yokes 240b to provide a current flow path, and second magnets 420b and second yokes 410b installed in the fixed base 200b to produce magnetic fields perpendicular to the current flowing through the tilt coils 430b, thereby producing an electromagnetic force capable of rotating the base plate 210. Here, the pair of tilt coils 430b are symmetrically arranged centering around the bobbin 230b, facing each second magnet 420b. Also, as shown in Figures. 21 through 23, the tilt coils 430b and the second magnet 420b are arranged such that only the upper parts of the tilt coils 430b overlap the second magnet 420b. In this overlapped state, current I flows through the pair of tilt coils 420b in the direction indicated by arrows as shown in Figure 21, the effect of the current flowing vertically through the tilt coils 420b is offset, and an electromagnetic force is produced in the direction F due to the interaction between the current I that flows horizontally and the magnetic fields B produced by the second magnets 420b, so that the base plate 210b rotates clockwise. On the contrary, when current I flows through the tilt coils 430b in the direction indicated by arrows as shown in Figure 22, an electromagnetic force is produced in the direction F due to the interaction with the magnetic field B by the second magnets 420b, so that the base plate 210b rotates counterclockwise. Also, as shown in Figure 23, when current I flows through the pair of tilt coils 430b installed at one side of the bobbin 230b, a force acts on that side downward. In this state, when the current flows through the pair of tilt coils 430b installed at the other side of the bobbin 230b, a force acts on the other side upward. As a result, the base plate 210b rotates in the direction A indicated by the arrow. Thus, the rotation direction of the base plate 210b can be controlled by controlling the direction of current flowing through the tilt coils 430b. Reference numeral 500b represents a controller for controlling the current flow through the tilt coils 430b and through the focusing coils 260b and the tracking coils 270b.

[0027] In the optical pickup constructed as above, when the optical disk 300b for a data recording/reproduction is level as shown in Figure 24, current does not flow through the tilt coils 430b and accordingly the base plate 210b maintains the level state without rotation. In this state, the focusing operation by the focusing coils 260b, the tracking coils 270b, the first magnets 250b and the first yokes 240b is also performed.

[0028] Also, when the optical disk 300b tilts to the right as shown in Figure 25, the controller 500b allows current to flow through the tilt coils 430b in the direction indicated in Figure 21 to rotate the base plate 210b clockwise such that the optical axis C passing through the objec-

tive lens 190b and the reflecting mirror 180b is incident perpendicularly to the optical disk 300b. That is, the base plate 210b is rotated being tilted as much as the optical disk 300b such that the optical axis C is perpendicular to the optical disk 300b.

[0029] Meanwhile, when the optical disk 300b tilts to the left as shown in Figure 26, the controller 500b allows current to flow through the tilt coils 430b in the direction indicated in Figure 22, to rotate the base plate 210b couterclockwise.

[0030] The tilting of the optical axis C passing through the objective lens 190b and the reflecting mirror 180b can be dynamically offset by rotating the base plate 210b according to the tilt of the optical disk 300b.

[0031] Also, the second magnets 420b are arranged to overlap with only the upper parts of the tilt coils 430b. However, the electromagnetic force as above can be produced when the second magnets 420b overlaps the lower parts of the tilt coils 430b.

[0032] An optical pickup according to a fourth embodiment of the present invention will be described with reference to Figures. 27 through 29, which also comprises extra coils for tracking and tilting separately.

[0033] Referring to Figures. 27 and 28, a base plate 700 is coupled by a screw S to a fixed base 500 in which a fixed optical system 900 is installed. The fixed optical system 900 comprises the same elements as in the first, second and third embodiments. Also, first magnets 730 and first inner and outer yokes 710 and 720, for producing an electromagnetic force capable of driving a bobbin 800 through interaction with a focusing coil 820 and tracking coils 830. are installed in the base plate 700. The first magnets 730 and the first inner and outer yokes 710 and 720 are fixed at all times because the base plate 700 is coupled to the fixed base 500 by the screw S. Meanwhile a rotary block 600 in which a reflecting mirror 610 is mounted is rotatably installed in the fixed base 500. That is. rotary protrusions 601 and 602 formed at the front and back of the rotary block 600 are inserted into coupling holes 501 and 502 formed in the fixed base 500 such that the rotary block 600 is rotatably supported by the fixed base 500. In particular, the rotary protrusion 601 formed at the front of the rotary block 601 has a hollow 601a through which the light emitted from the fixed optical system 900 reaches the reflecting mirror 610. Also. a pair of tilt coils 621 and 622, a pair of second magnets 630 and second inner and outer yokes 650 and 640 are installed as a tilt means on both sides of the rotary block 600. The tilt means produces an electromagnetic force for rotating the rotary block 600 centering around a rotary axis C shown in Figure 28. As shown in Figure 29, the tilt coils 621 and 622 are arranged such that the center parts of the tilt coils 621 and 622 overlap the second magnets 630. Reference numerals 623 and 624 represent iron cores around which the tilt coils 621 and 622 are wound for attraction with the second magnets 630, which contributes to up-and-down balance of the magnetic field lines with the second magnet 600, such that the rotary block 600 is level. Thus, the irons cores 623 and 624 are arranged to be symmetrical in the vertical direction to the magnetic force of the second magnet 630. Also, a holder 850 having wires 840 supporting the bobbin 800 is mounted on the rotary block 600. That is, coupling protrusions 851 formed on the bottom of the holder 850 are inserted into coupling holes 603 formed in the top of the rotary block 600, such that the holder 850 is fixed to the rotary block 600. Thus, as the rotary block 600 rotates, the holder 850 and the bobbin 800 supported by the holder 800 rotate together. Also, an objective lens 810, the focusing foil 820 and the tracking coils 830 are installed in the bobbin 800. As the holder 850 is coupled to the rotary block 600, the focusing coil 820 and the tracking coils 830 are placed between the first magnets 730 attached to the first outer yokes 720, and the first inner yokes 710. Thus, the bobbin 800 moves being supported by the wires 840 due to the current flowing through the focusing coil 820 and the tracking coils 830, and magnet field lines due to the first magnets 730 and the first inner and outer yokes 710 and 720. Accordingly, the objective lens 810 can perform the focusing and tracking operations.

[0034] In the optical pickup having the above-described structure, the tilt means rotates the rotary block 600 such that the optical axis passed through the objective lens 810 is incident perpendicular to an optical disk (not shown). That is, when the current I flows through the tilt coils 621 and 622 placed at one side of the rotary block 600, an electromagnetic force F is produced upward due to the interaction with the magnetic field lines B by the second magnents 630. Also, when the current I flows in the opposite direction through the tilt coils 621 and 622 placed at the other side, an electromagnetic force is produced downward. As a result, the rotary block 600 rotates centering around the rotary axis X. When the current flows the tilt coils 621 and 622 in the opposite direction to the above, the rotary block 600 rotates in the opposite direction.

[0035] In the optical pickup according to the fourth embodiment of the present invention, the rotary block 600 that is integrally movable with the holder 850 of the bobbin 800 is rotated according to the tilt of an optical disk, so that the tilt of the optical axis passing through, the objective lens 810 and the reflecting mirror 610 can be dynamically compensated for.

[0036] In addition, in the optical pickup having the above structure according to the fourth embodiment, the first magnets 730 and the first inner and outer yokes 710 and 720 for the tracking and focusing operations are fixed to the base plate 700 connected with the fixed base 500, the weights of the first magnets 730 and the first inner and outer yokes 710 and 720 do not affect at all the rotary operation for the tilt adjustment. That is, since only the rotary block 600, and the bobbin and holder 850 which are integrally connected to the rotary block 600, rotate for the tilt operation, the weight of objects to rotate for the tilt operation become light compared to that in

the first, second and third embodiments. Thus, mass inertial moment for the tilt operation decreases, so that the driving sensitivity is enhanced, and the tilt adjustment can be performed with a low driving current.

[0037] As described above, in optical pickups according to embodiments of the present invention, the tilt of the optical axis of the light incident onto and reflected by an optical disk through the reflecting mirror and the objective lens can be adjusted according to the tilt of the recording medium, such that the light is perpendicularly incident onto and reflected by the recording medium at all times.

[0038] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0039] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0040] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0041] The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. An optical pickup comprising:
   a fixed base (200);

   a base plate (210) installed rotatable with respect to the fixed base (200);

   a bobbin (230) seated on the base plate (210), being movably supported by a predetermined wire (280);

   an objective lens (190) for focusing an incident light to form a spot of light on a recording medium (300), the objective lens (190) mounted in the bobbin (230);

   focusing coils (260) serving as a current flow path for a focusing operation, the focusing coils (260) installed in the bobbin (230);

   first magnets (250) and first yokes (240) for producing magnetic fields perpendicular to the current flowing through the focusing coils (260) to produce an electromagnetic force for driving the bobbin (230), the first magnets (250) and first yokes (240) installed in the base plate (210);

   a fixed optical system (100) for irradiating light toward the recording medium (300) and receiving the light reflected by the recording medium (300) and then passed through the objective lens (190); and

   a reflecting mirror (180) for changing the traveling path of the incident light, the reflecting mirror (180)arranged between the objective lens (190) and the fixed optical system (100), being fixed to the base plate;

   a support arm (182) having one end fixed to the fixed base (200) and the other end rotatably supporting the reflecting mirror (180), serving as a rotary shaft of the base plate to which the reflecting mirror (180) is fixed; and

   a tilt means for rotating the base plate (210) using the support arm (182) as a rotary shaft, to adjust the tilt of an optical axis passing through the objective lens (190) and the reflecting mirror (180).

2. The optical pickup of claim 1, wherein the tilt means comprises:

   tilt coils (430) serving as a current flow path, the tilt coils (430) being attached to the first yokes (240); and

   second magnets (420) and second yokes (410) for producing a magnetic field perpendicular to the current flowing through the tilt coils (430) to produce an electromagnetic force for rotating the base plate (210), the second magnets (420) and second yokes (410) installed in the fixed base.

3. An optical pickup comprising:

   a fixed base (200a);

   a base plate (210a) installed rotatable with respect to the fixed base (200a);

   a hollow boss (201) formed to protrude on the

base plate (210a);

a bobbin (230a) coupled to the boss (201) to be movable in the vertical direction;

an objective lens (190a) for focusing an incident light to form a spot of light on a recording medium (300a), the objective lens (190a) being mounted in the bobbin (230a);

focusing coils (260a) serving as a current flow path for a focusing operation, the focusing coils (260b) being installed in the bobbin (230a);

first magnets (250a) and first yokes (240a) for producing magnetic fields perpendicular to the current flowing through the focusing coils (260a) to produce an electromagnetic force for driving the bobbin (230a), the first magnets (250a) and first yokes (240a) being installed in the base plate (210a);

a fixed optical system (100a) for irradiating light toward the recording medium (300a) and receiving the light reflected by the recording medium (300a) and then passed through the objective lens (190a);

a reflecting mirror (180a) for changing the traveling path of the incident light, the reflecting mirror (180a) being arranged between the objective lens (190a) and the fixed optical system (100a), being fixed to the base plate (210a);

a support arm (182a) having one end fixed to the fixed base (200a) and the other end rotatably supporting the reflecting mirror (180a), serving as a rotary shaft of the base plate (210a) to which the reflecting mirror (180a) is fixed; and

a tilt means for rotating the base plate (210a) using the support arm (182a) as a rotary shaft, to adjust the tilt of an optical axis passing through the objective lens (190a) and the reflecting mirror (180a).

4. The optical pickup of claim 3, wherein the tilt means comprises:

tilt coils (430a) serving as a current flow path, the tilt coils attached to the bobbin (230a); and

second magnets (420a) and second yokes (410a) for producing magnetic fields perpendicular to the current flowing through the tilt coils (430a) to produce an electromagnetic force for rotating the base plate (210a) coupled to the bobbin (230a), the second magnets (420a) and second yokes (410a) installed in the fixed base (200a).

5. An optical pickup comprising:

a fixed base (200b);

a base plate (210b) in the fixed base (200b), being supported by spring means (440b) to be rotatable;

a bobbin (230b) seated on the base plate (210b), being supported by a predetermined wire (280b) to be movable;

an objective lens (190b) for focusing an incident light to form a spot of light on a recording medium (300b), the objective lens (190b) mounted in the bobbin (230b);

a focusing coil (260b) and tracking coils (270b) serving as a current flow path for focusing and tracking operations, the focusing coil (260b) and tracking coils (270b) installed in the bobbin (230b);

first magnets (250b) and first yokes (240b) for producing magnetic fields perpendicular to the current flowing through the focusing coil (260b) and the tracking coils (270b) to produce an electromagnetic force for driving the bobbin (230b), the first magnets (250b) and first yokes (240b) installed in the base plate (210b);

a fixed optical system (100b) for irradiating light toward the recording medium (300b) and receiving the light reflected by the recording medium (300b) and then passed through the objective lens (190b);

a reflecting mirror (180b) for changing the traveling path of the incident light, the reflecting mirror (180b) arranged between the objective lens (190b) and the fixed optical system (100b), being fixed to the base plate (210b); and

a tilt means for elastically rotating the base plate (210b) which is elastically supported by the springs (440b), to adjust the tilt of an optical axis passing through the objective lens (190b) and the reflecting mirror.

6. The optical pickup of claim 5, wherein the tilt means comprises:

tilt coils (430b) serving as a current flow path, the tilt coils (430b) attached to the first yokes

(240b); and

second magnets (420b) and second yokes (410b) for producing a magnetic field perpendicular to the current flowing through the tilt coils (430b) to produce an electromagnetic force for rotating the base plate (210b), the second magnets (420b) and second yokes (410b) installed in the fixed base (200b).

7. An optical pickup comprising:

a fixed base (500);

a rotary block (600) installed in the fixed base (500) to be rotatable;

a holder (850) integrally coupled to the rotary block (600);

a bobbin (800) supported by a predetermined wire (840) of the holder (850) to be movable;

a base plate (700) fixed to the fixed base (500) and placed between the rotary block (600) and the bobbin (800);

an objective lens (810) for focusing an incident light to form a spot of light on a recording medium, the objective lens (810) mounted in the bobbin (800);

a focusing coil (820) and tracking coils (830) serving as a current flow path for focusing and tracking operations, the focusing coil (820) and tracking coils (830) installed in the bobbin;

first magnets (730) and first inner and outer yokes (710; 720) for producing magnetic fields perpendicular to the current flowing through the focusing coil (820) and the tracking coils (830) to produce an electromagnetic force for driving the bobbin (800), the first magnets (730) and first inner and outer yokes (710; 720) installed in the base plate (700), facing the focusing coil (820) and the tracking coils (830);

a fixed optical system (900) for irradiating light toward the recording medium and receiving the light reflected by the recording medium and then passed through the objective lens (810);

a reflecting mirror (610) for changing the traveling path of the incident light, the reflecting mirror (610) installed in the rotary block (600) to be arranged between the objective lens (810) and the fixed optical system (900); and

a tilt means for rotating the rotary block (600) to adjust the tilt of an optical axis passing through the objective lens (810) and the reflecting mirror (610).

8. The optical pickup of claim 7, wherein the tilt means comprises:

tilt coils (621, 622) serving as a current flow path, the tilt coils (621, 622) installed at both sides of the rotary block (600); and

second magnets (630) and second inner and outer yokes (640; 650) for producing magnetic fields perpendicular to the current flowing through the tilt coils (621, 622) to produce an electromagnetic force for rotating the rotary block (600), the second magnets (630) and second inner and outer yokes (640; 650) installed facing the tilt coils (621, 622).

9. The optical pickup of claim 8, wherein a plurality of iron cores (623, 624) are installed at both sides of the rotary block (600) to be symmetrical in the vertical direction such that the rotary block (600) maintains a level state due to the magnetic force between the second magnets (630) and the second inner and outer yokes (640; 650).

FIG. 1 (PRIOR ART)

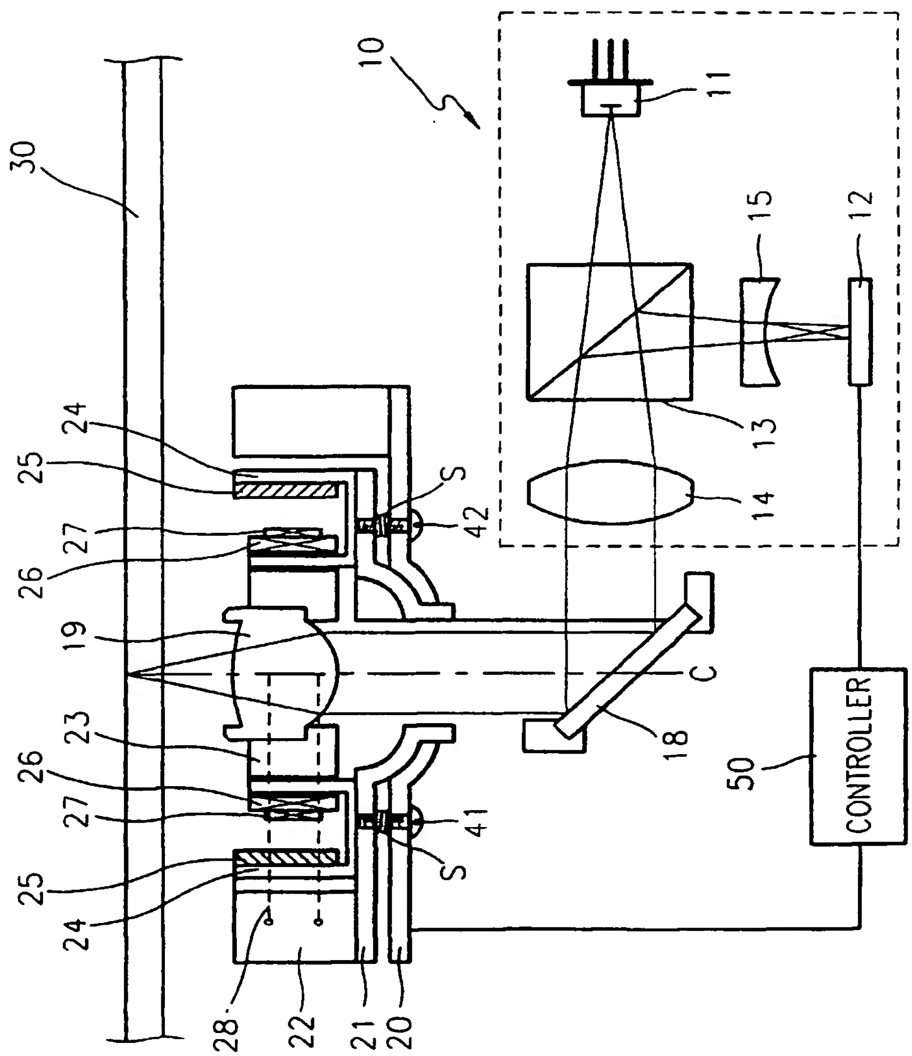
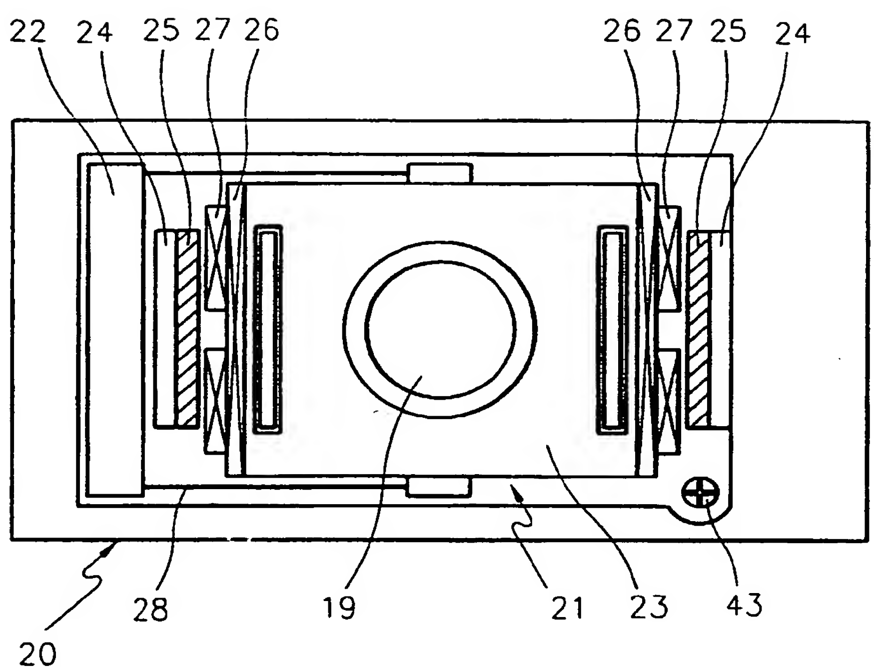
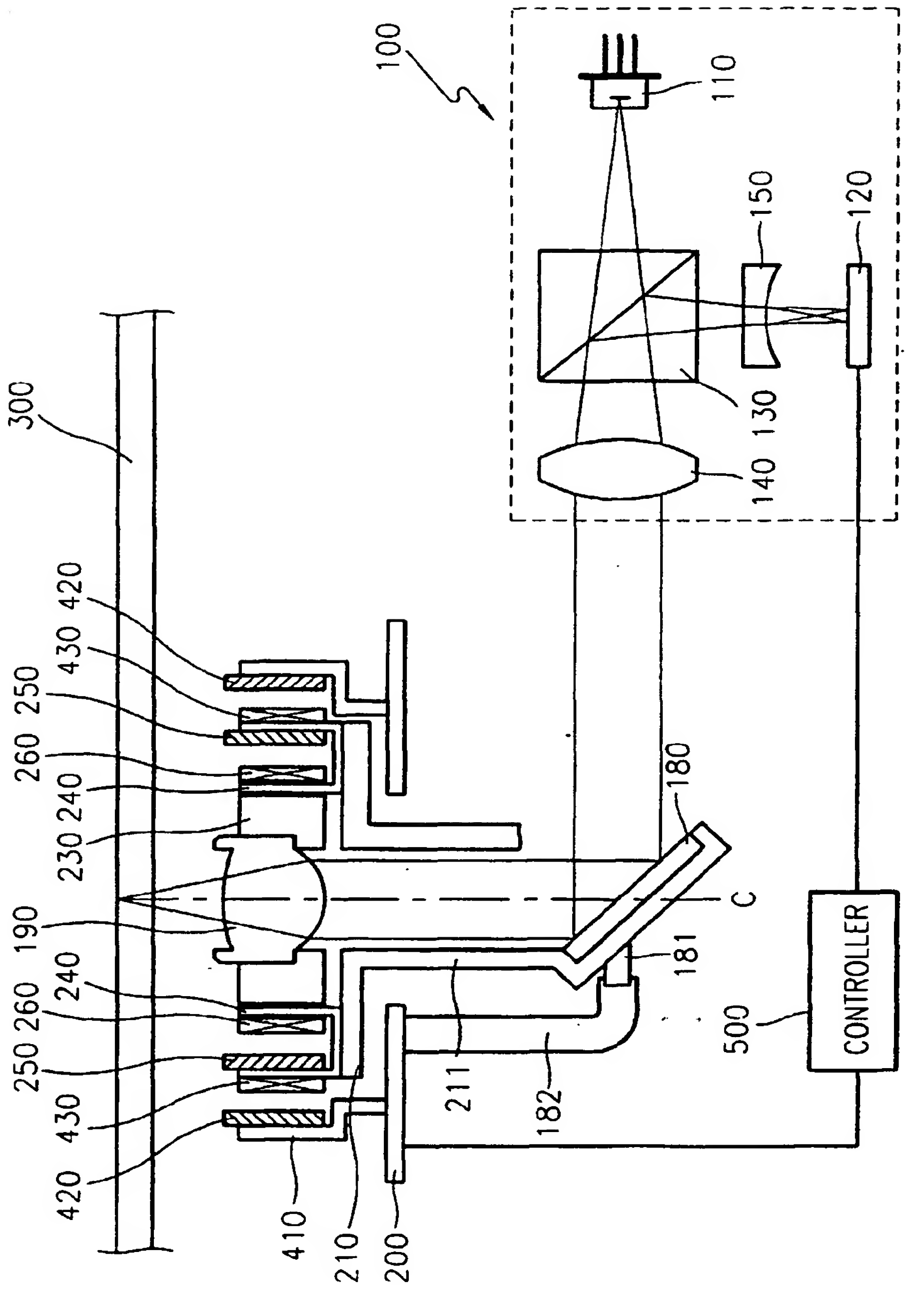


FIG. 2 (PRIOR ART)




100
110
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130
140
300
420
430
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260
240
230
190
180
181
182
211
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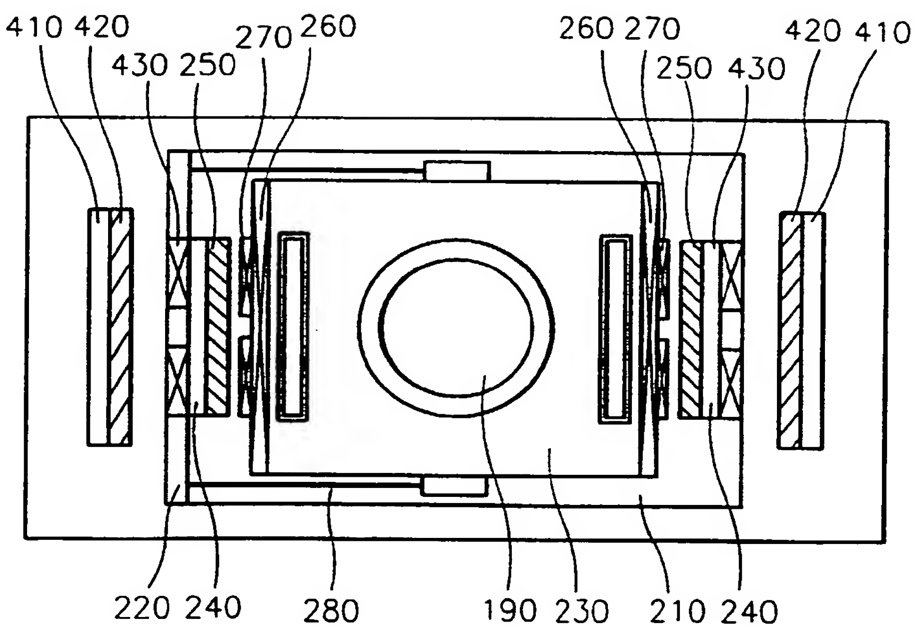
500
CONTROLLER
410
210
200

FIG. 3

FIG. 4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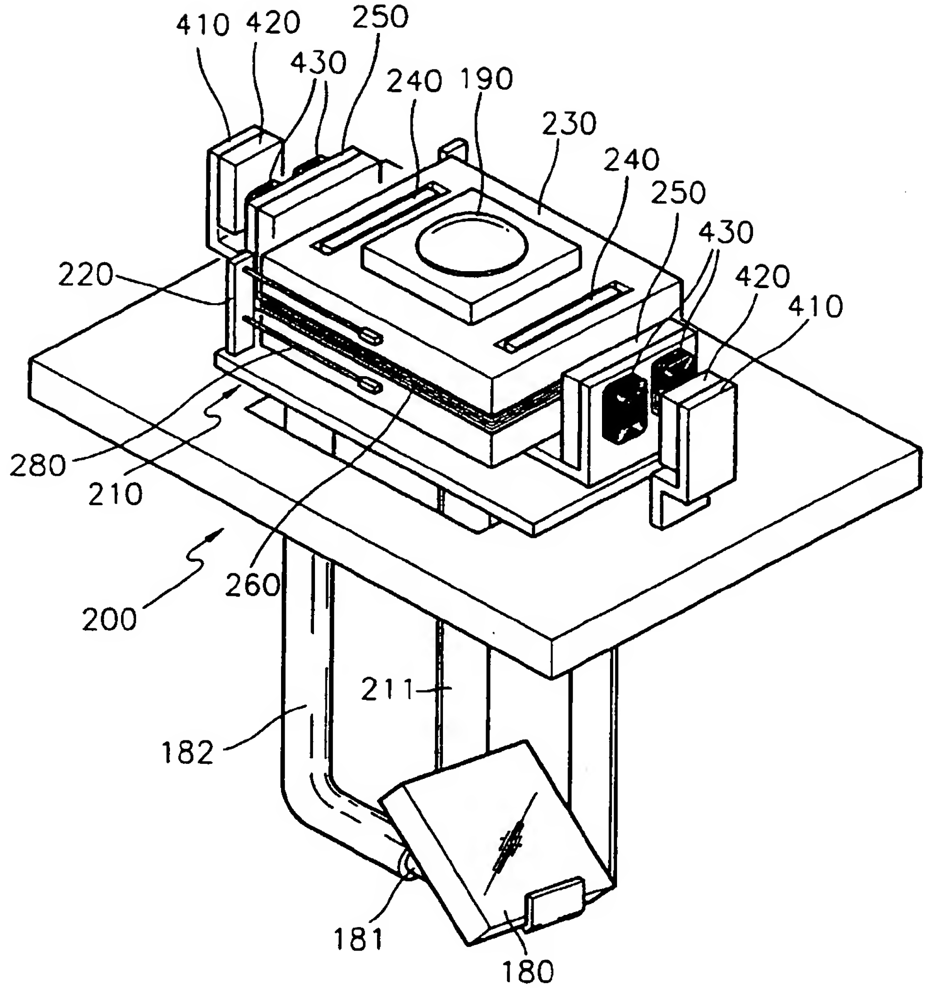
430 250
270 260
260 270
250 430
420 410
220 240
280
190 230
210 240

FIG. 5


410
420
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420
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200
211
182
181
180

FIG. 6

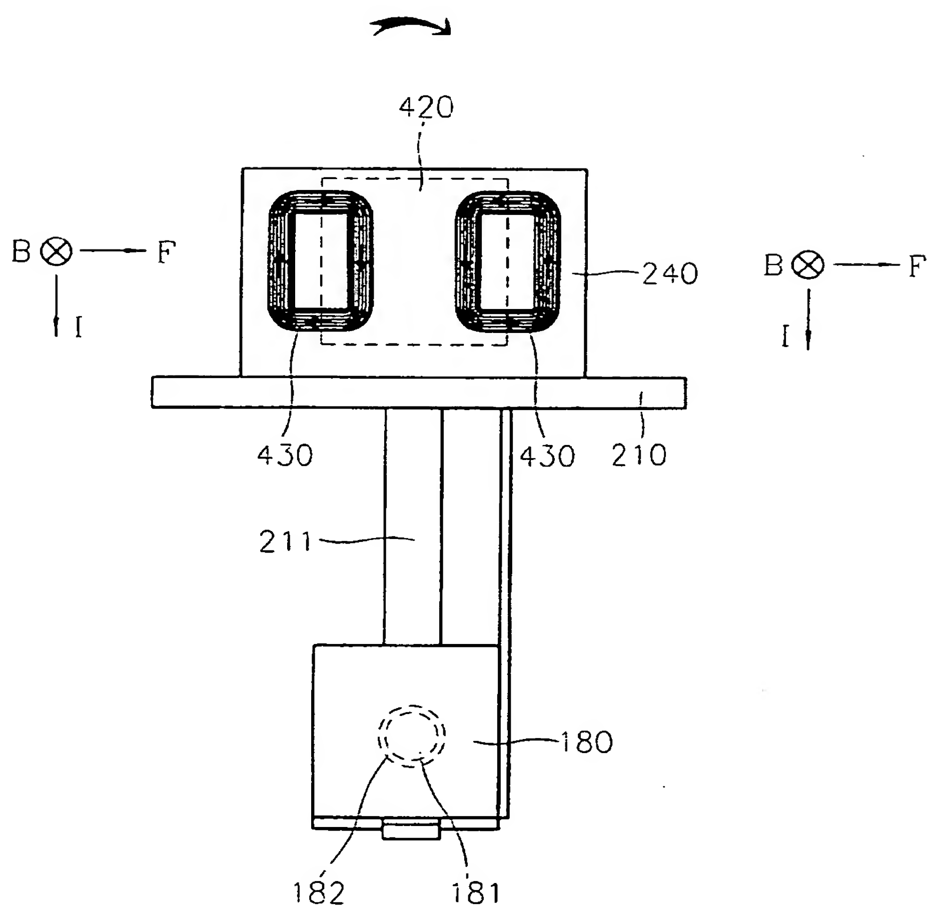


FIG. 7

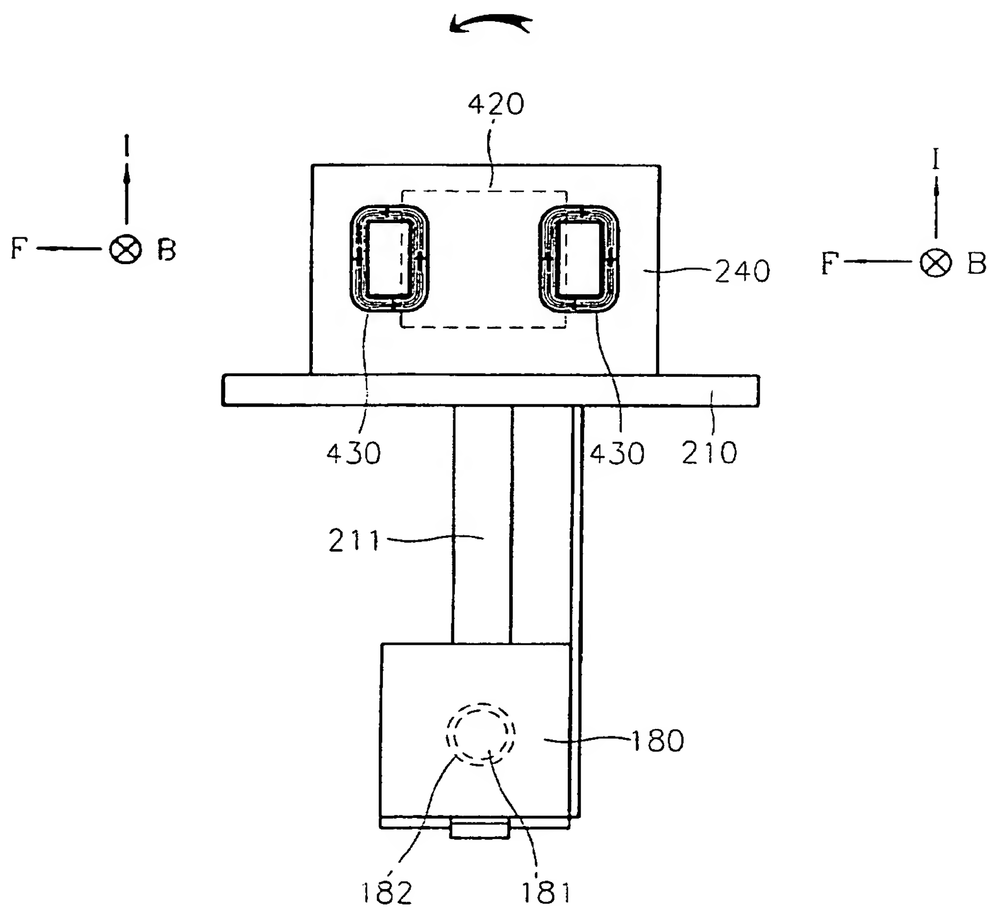


FIG. 8

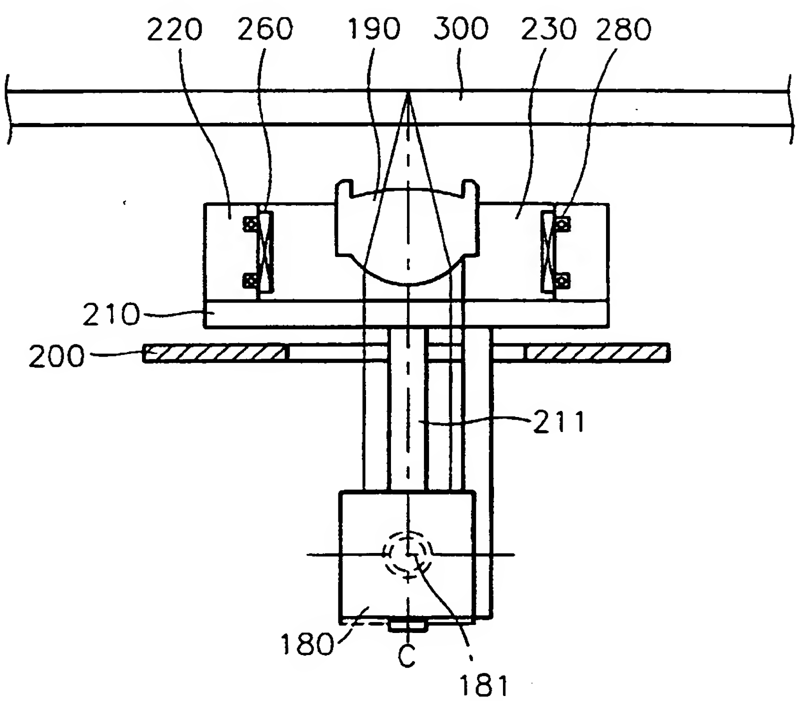


FIG. 9

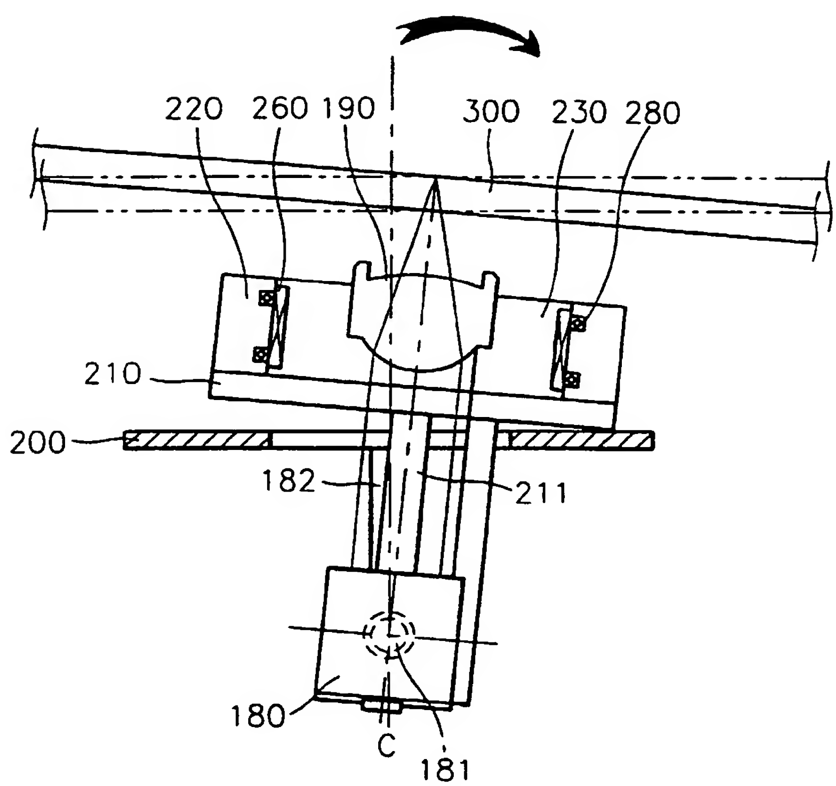


FIG. 10

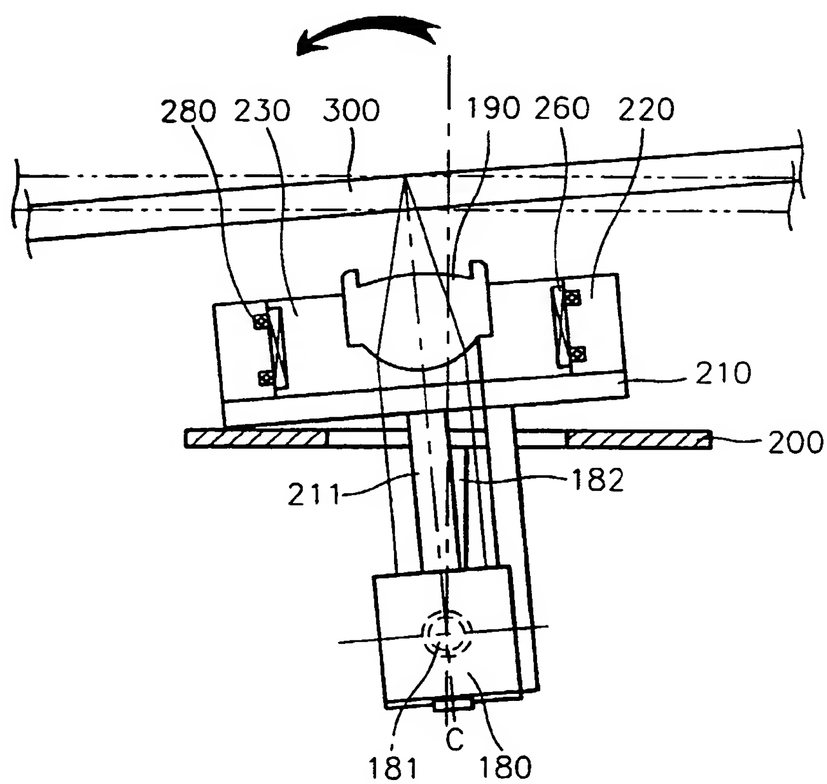
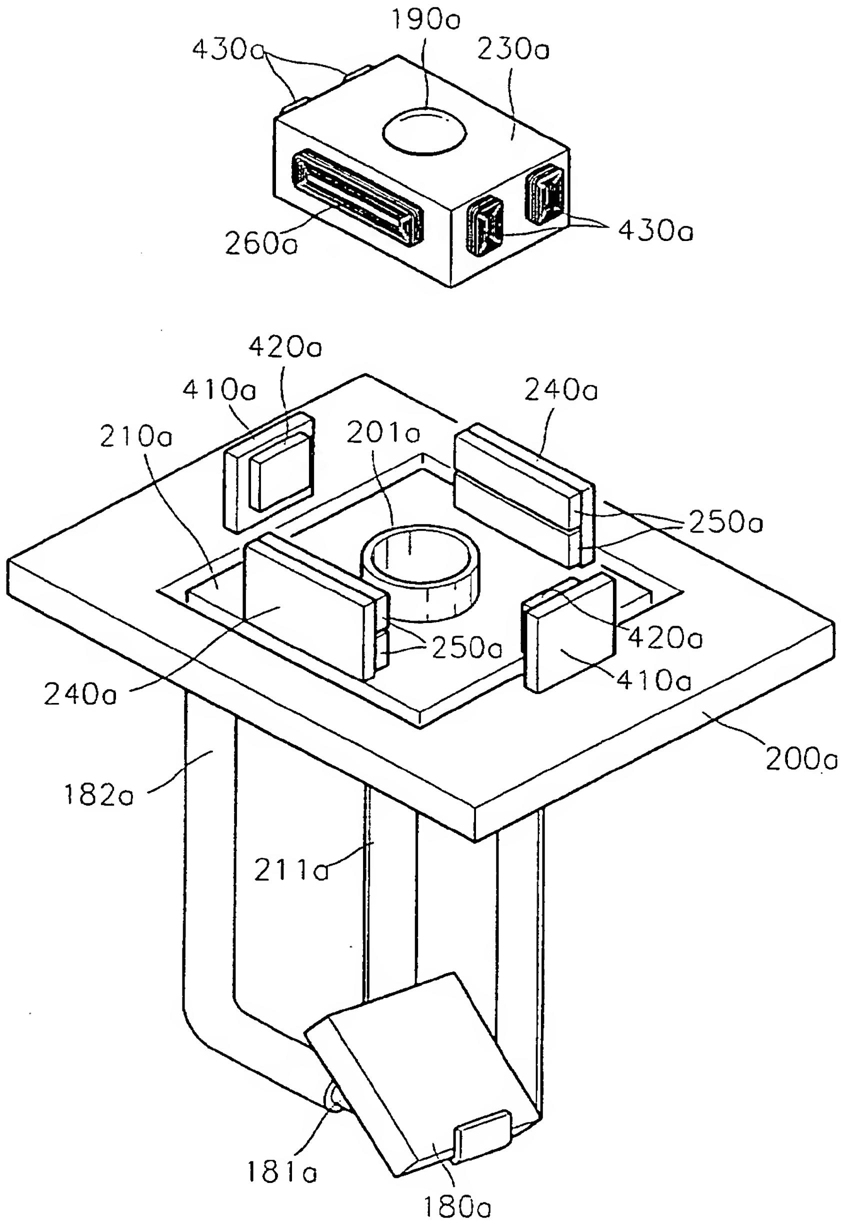


FIG. 11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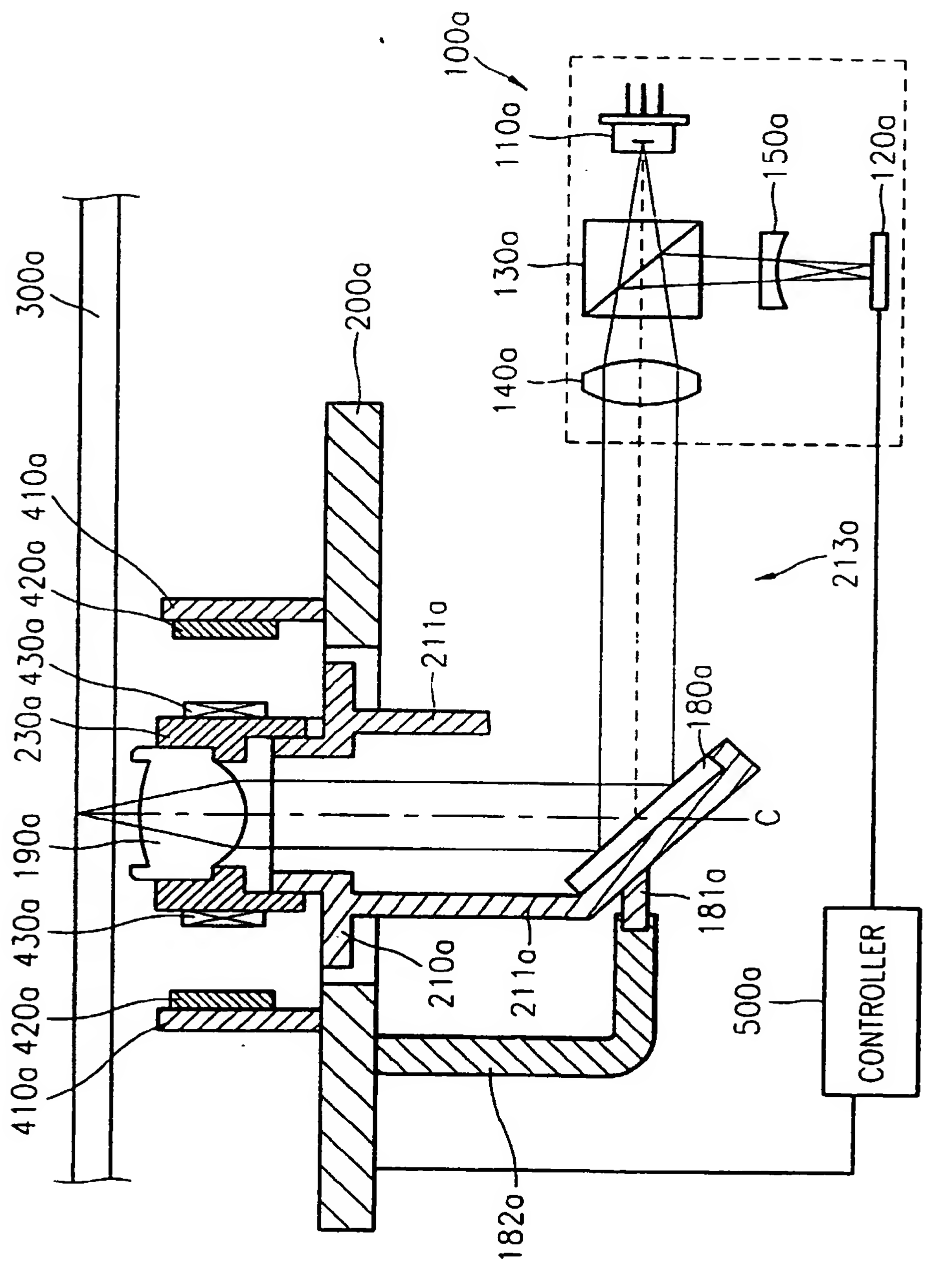
211a
181a
180a

FIG. 12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150a
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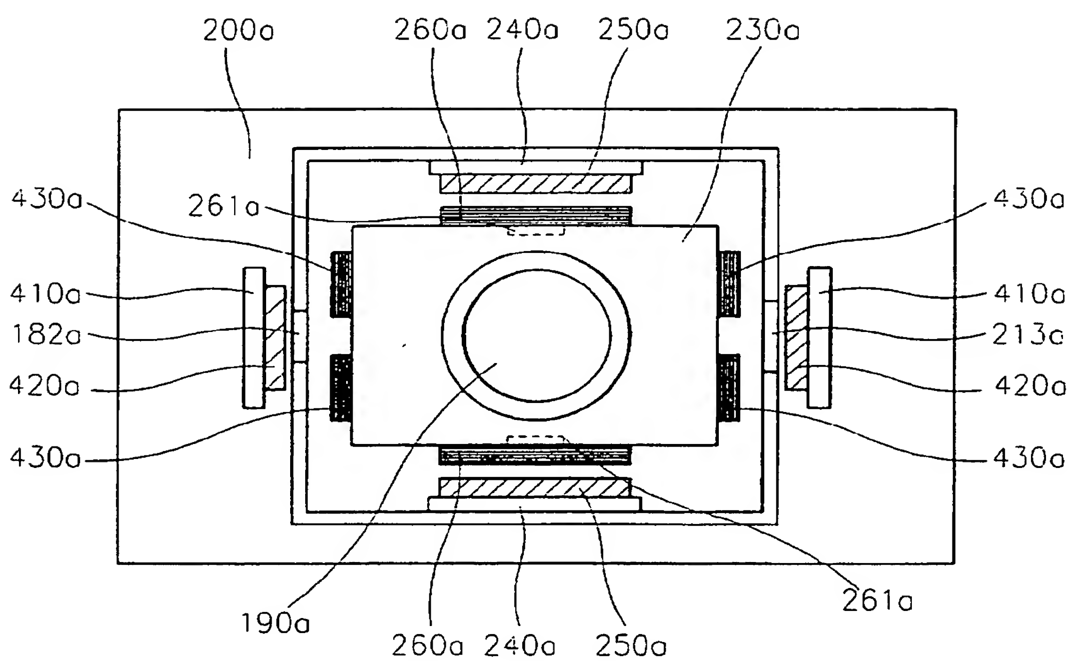
230a
190a
211a
213a
180a
C
181a
210a
500a
CONTROLLER
182a

FIG. 13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430a
190a
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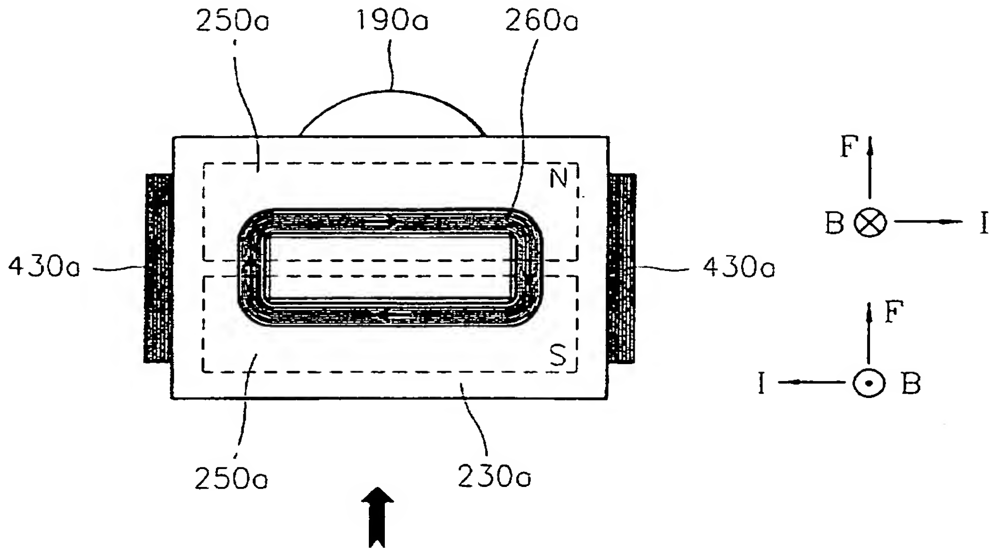
240a
250a
261a

FIG. 14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S
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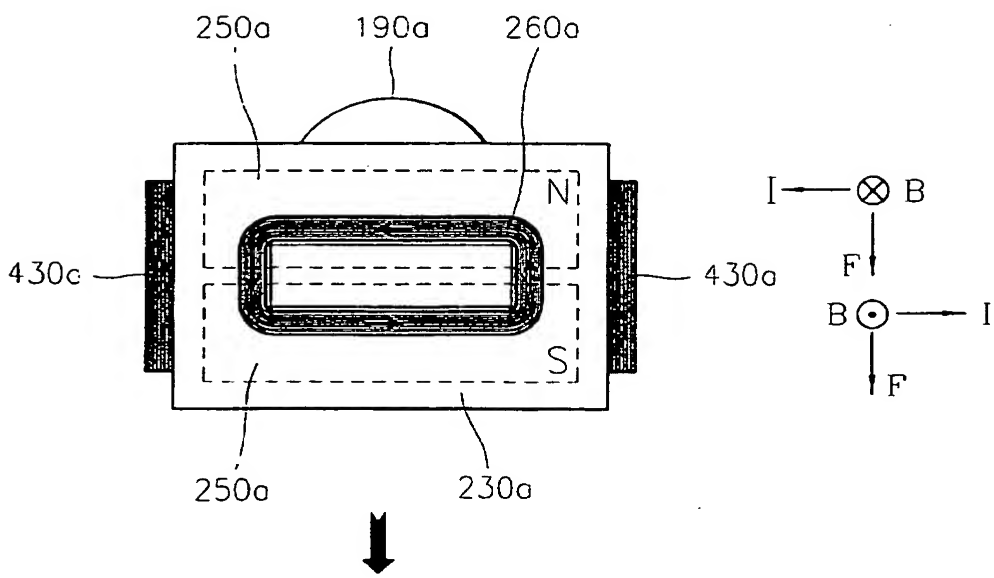
230a
F
B
I
F
I
B

FIG. 15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260a
N
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S
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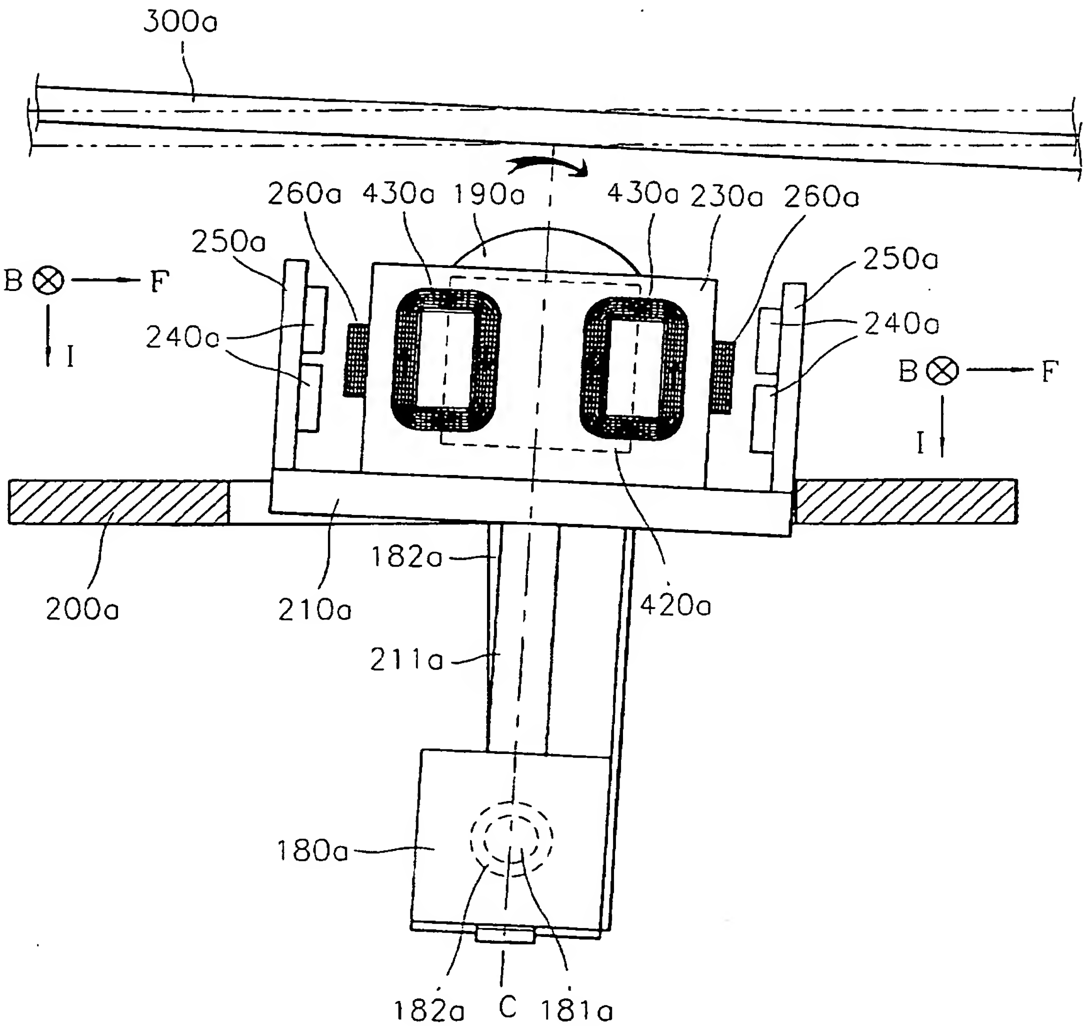
230a
I
B
F
B
I
F

FIG. 16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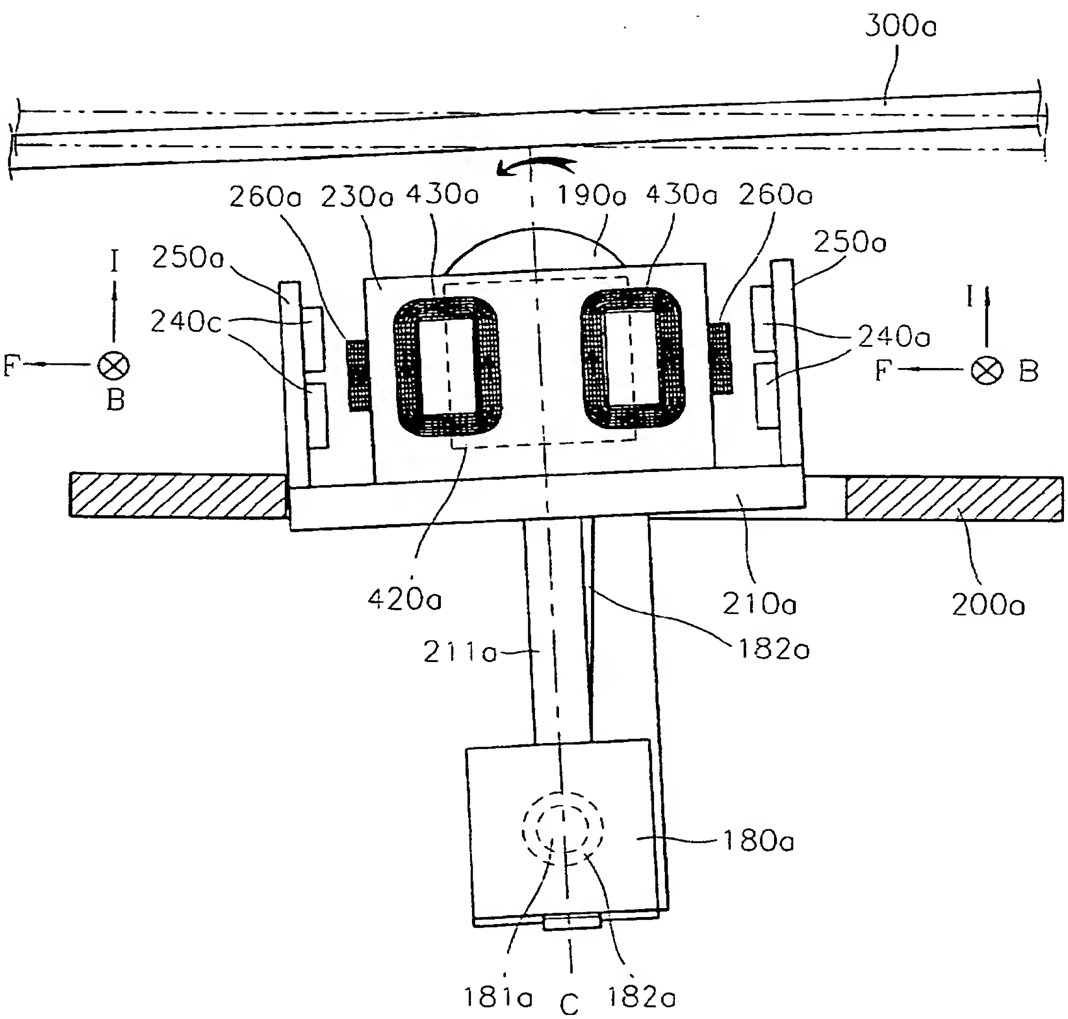
250a
B
F
I
240a
240a
B
F
I
200a
210a
182a
420a
211a
180a
182a
C
181a

FIG. 17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I
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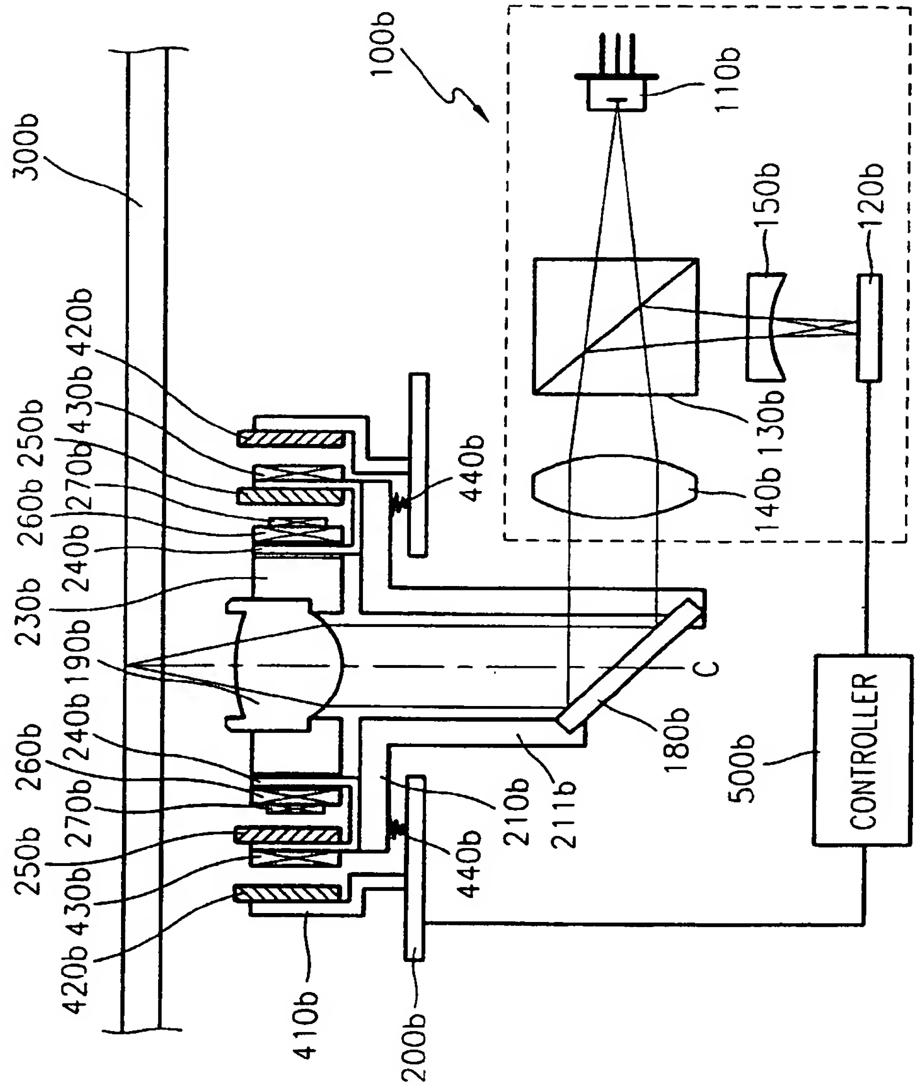
200a
211a
182a
180a
181a
C
182a

FIG. 18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C
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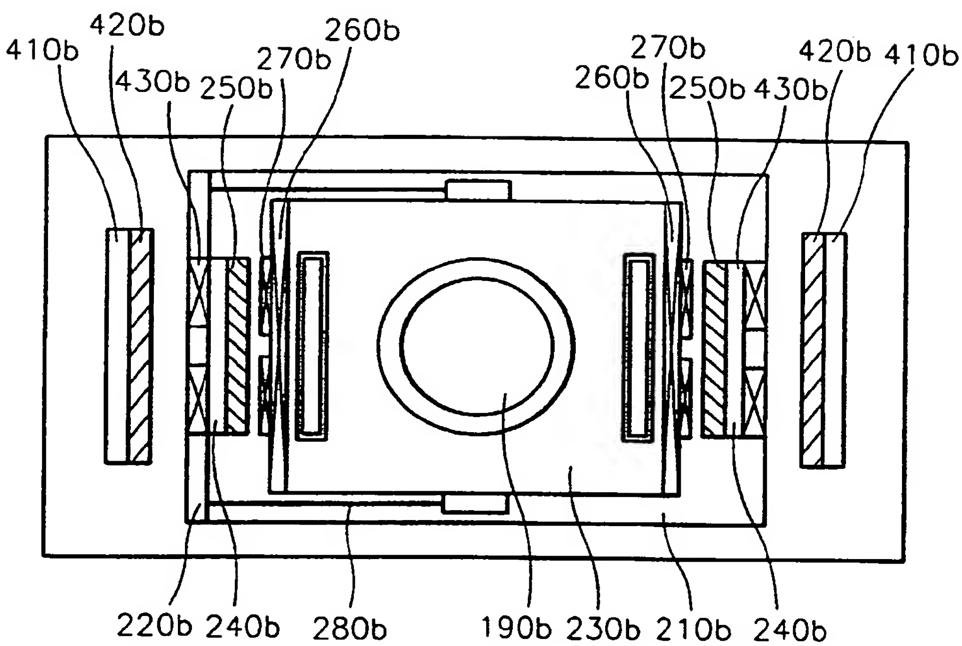
211b
500b
CONTROLLER
410b
200b

FIG. 19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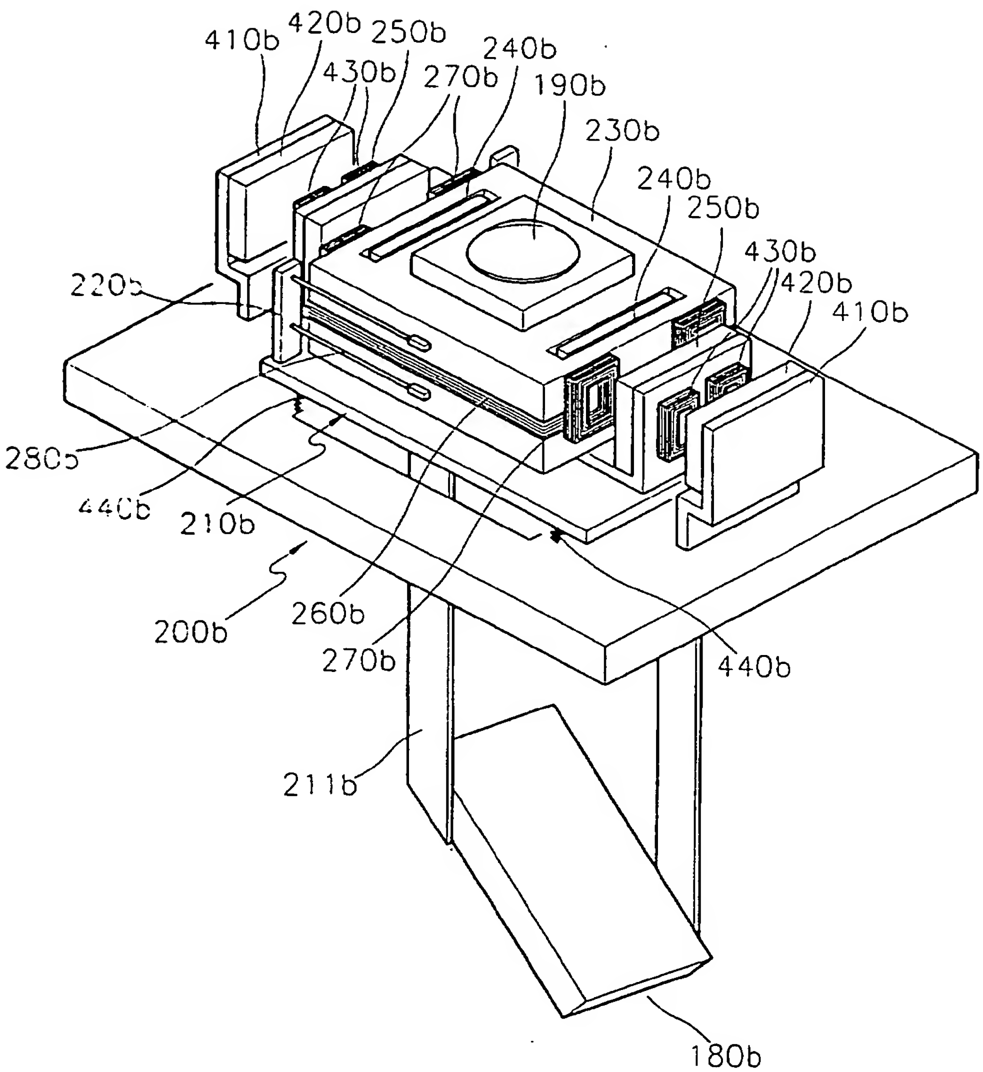
210b
240b

FIG. 20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270b
440b
211b
180b

FIG. 21

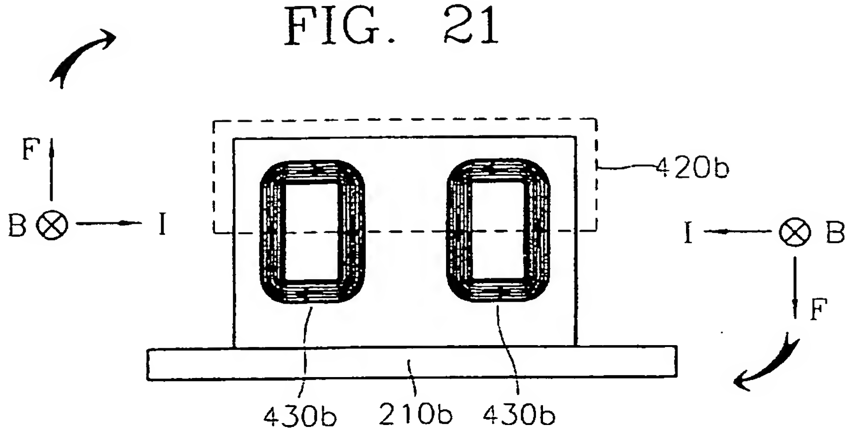


FIG. 22

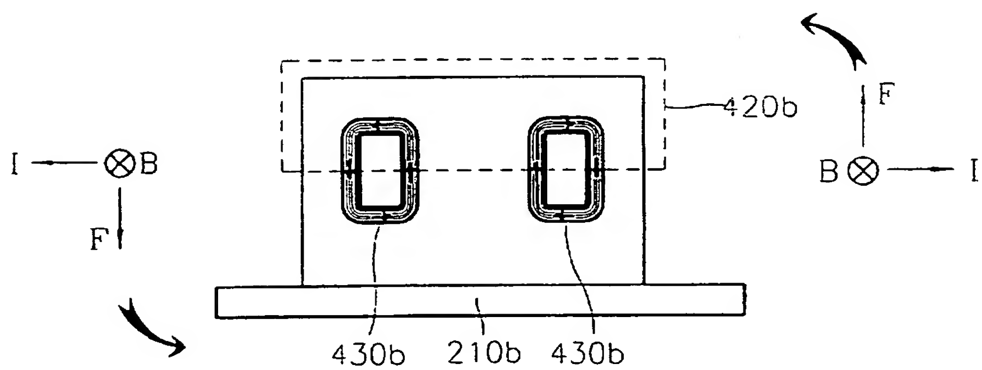


FIG. 23

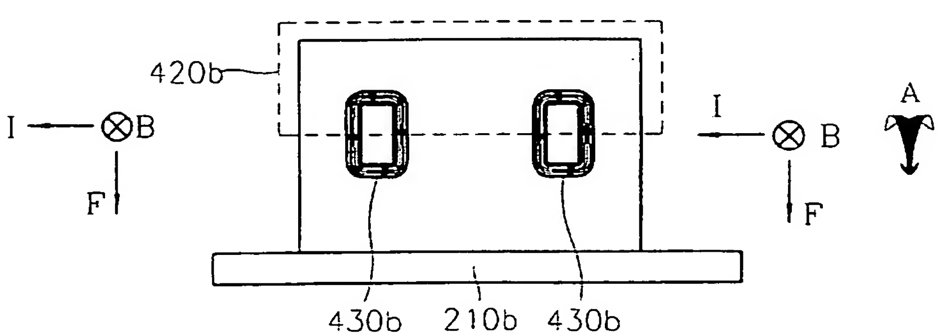
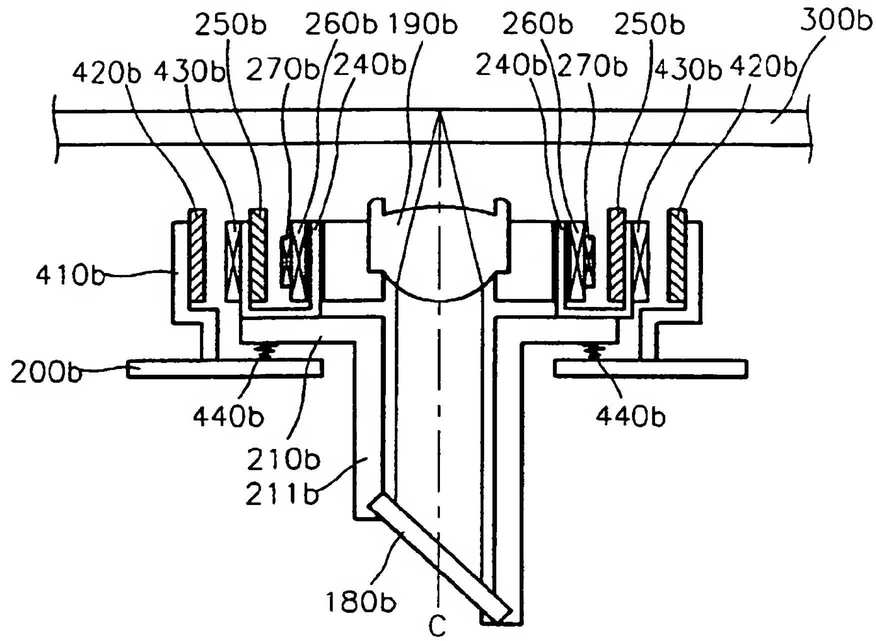


FIG. 24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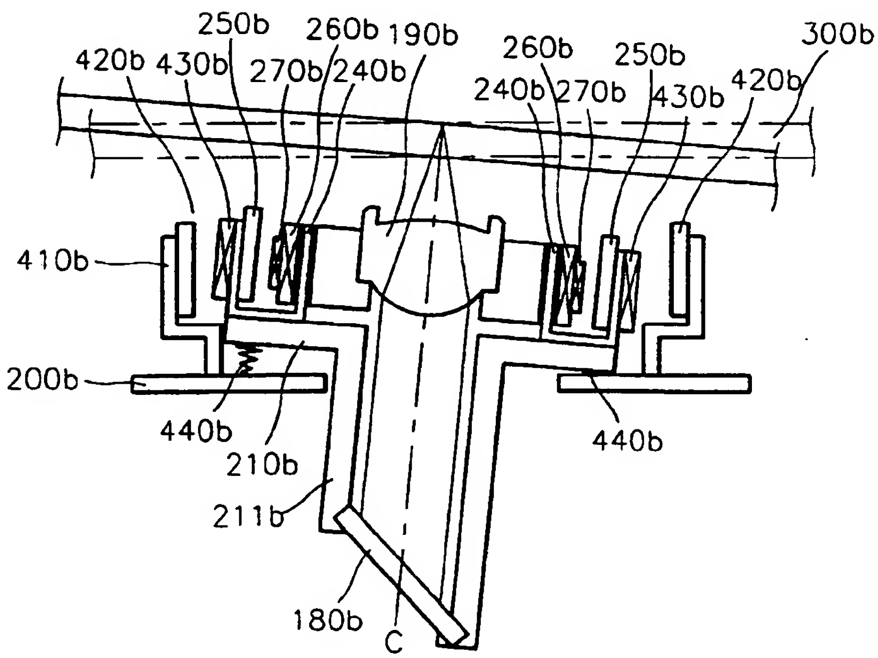
211b
180b
C

FIG. 25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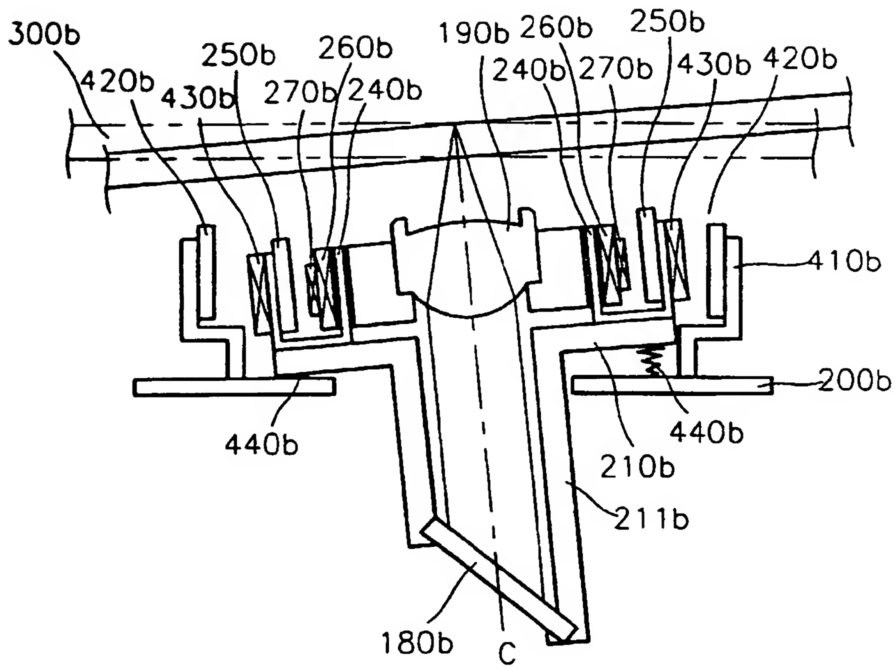
211b
180b
C

FIG. 26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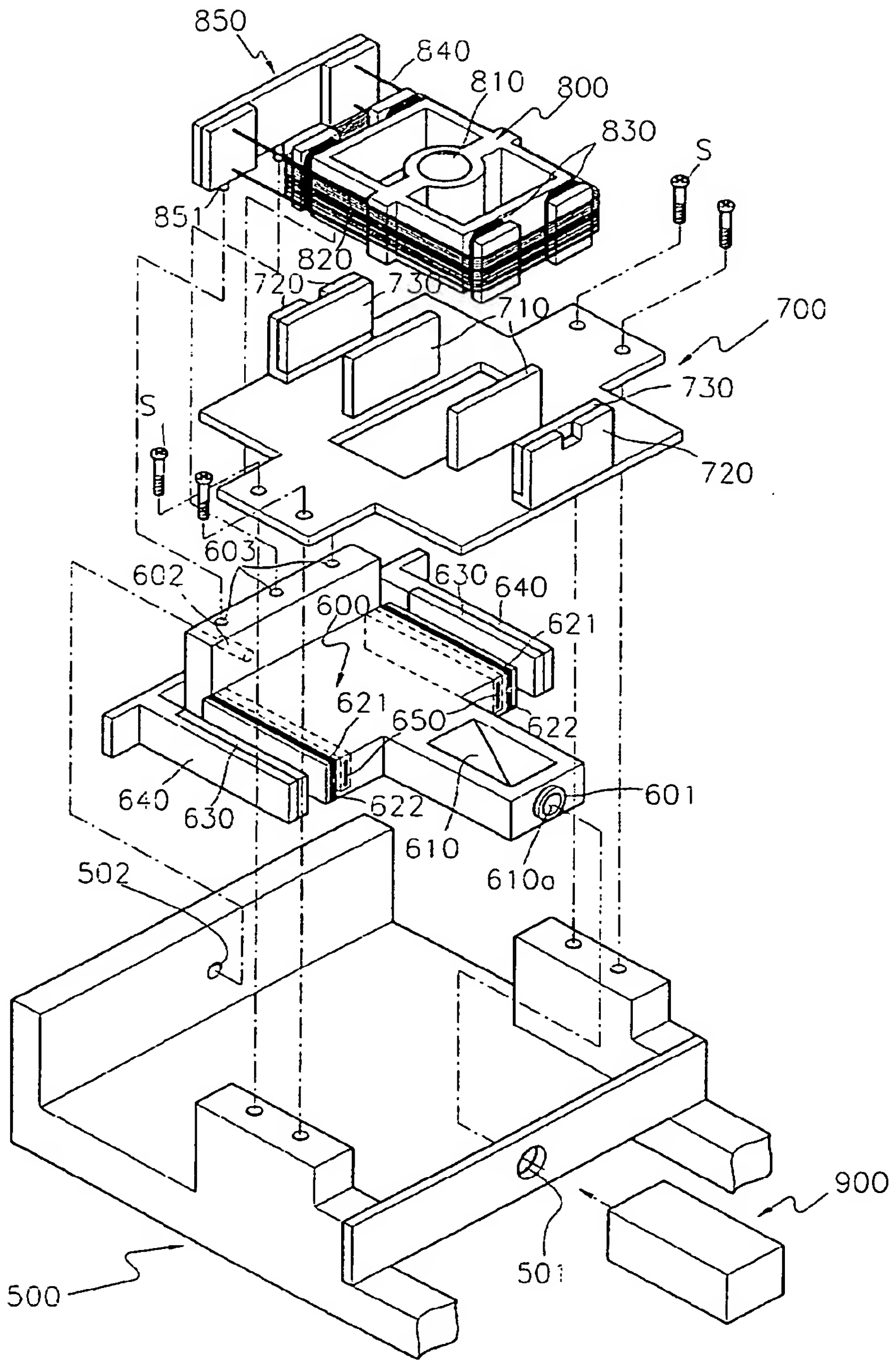
180b
C

FIG. 27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810
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830
S
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720
730
710
700
730
720
S
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602
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650
622
622
640
630
601
610
610a
502
900
500
501

FIG. 28

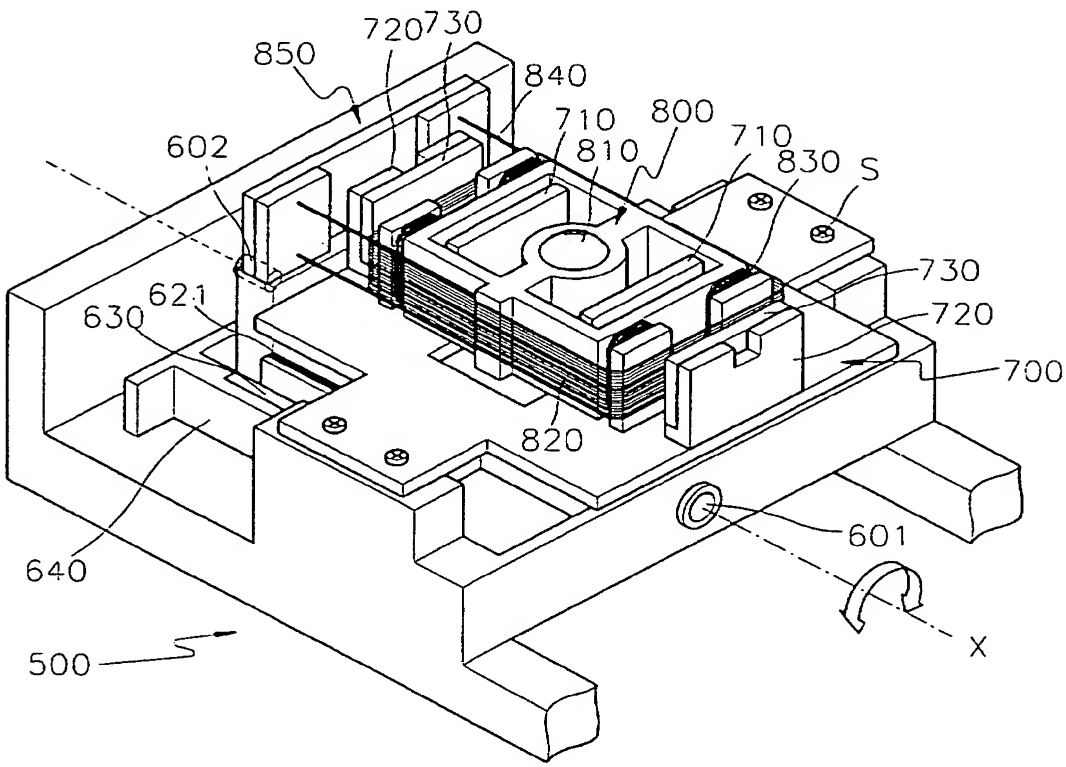
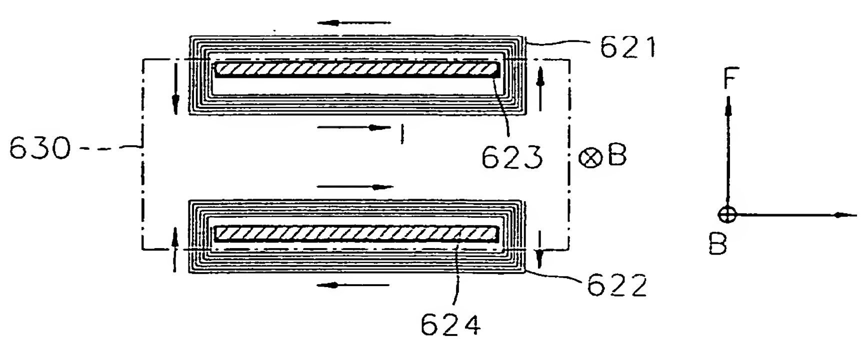

850
720
730
840
710
800
602
810
710
830
S
621
630
730
720
700
820
640
601
500
X

FIG. 29


621
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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 30 3981

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 472 084 A (TOKYO SHIBAURA ELECTRIC CO) 26 February 1992 (1992-02-26) * abstract * * column 4, line 8 - column 6, line 1; figures 1-3 *	1-9	G11B7/095 G11B7/09
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 August 1999	Annibal, P

CATEGORY OF CITED DOCUMENTS

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